PROCUREMENT SENSITIVE

Advanced Spectroscopic Portal (ASP) Performance Specification

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TABLE OF CONTENTS

FIGURES

EXECUTIVE SUMMARY

This specification identifies the performance requirements for an Advanced Spectroscopic Portal (ASP) incorporating gamma and neutron detection. The gamma detectors, with associated hardware and software, are capable of both gamma spectroscopic analysis and gamma gross counting. The neutron detectors, with associated hardware and software, are capable of neutron gross counting.

This Portal Monitor is capable of the isotopic identification of radioactive material within a vehicle or container for the purposes of automatically releasing vehicles carrying non-threatening radioactive sources, including naturally occurring radioactive material (NORM) and radioisotopes utilized for medical procedures.

ASP systems shall meet the requirements as described in ANSI N42.38-WD-F1a (Draft) Section 3.1.2 “Vehicle (includes road transported containers)”, along with the requirements listed in this document. Additional requirements described herein ensure compatibility with the existing United States Customs and Border Protection (CBP) infrastructure.

1.0 ASP SYSTEM ARCHITECTURE

1.1 Introduction

Portal Monitors have proven to be effective tools for the detection of illicit radioactive materials moving across international borders. It is important that these sensitive systems accurately detect and identify a variety of radionuclides that could be put to destructive use within the United States borders.

Radioactive materials that require interception at United States borders include special nuclear materials (SNM), such as plutonium and highly enriched uranium, which could be used as the basis for a nuclear weapon. However, when Portal Monitors are operated with sufficient sensitivity to detect SNM in quantities of concern, innocent alarms due to naturally occurring radioactive materials (NORM), medical isotope products, and industrial isotope products must be dealt with. Additionally, a wide variety of more common radionuclides and materials, including ^{60}Co, $^{90}Sr/^{90}Y$, ^{137}Cs, ^{192}Ir, ^{226}Ra, ^{241}Am, and ^{252}Cf are of concern when present in sufficient quantity for potential misuse, such as use in a radiological dispersal device (RDD). The challenge is to distinguish between SNM, and NORM, RDDs, and medical and industrial isotope products in a way that minimizes the impact on the cross border flow of people and commerce.

This specification identifies the performance and design features and tests for an ASP system incorporating gamma detectors with gamma spectroscopic analysis hardware and software that are used in combination with neutron detectors and gross-counting neutron analysis hardware and software. A notional view of a tractor-trailer rig passing through an ASP system is shown in Figure 1-1.

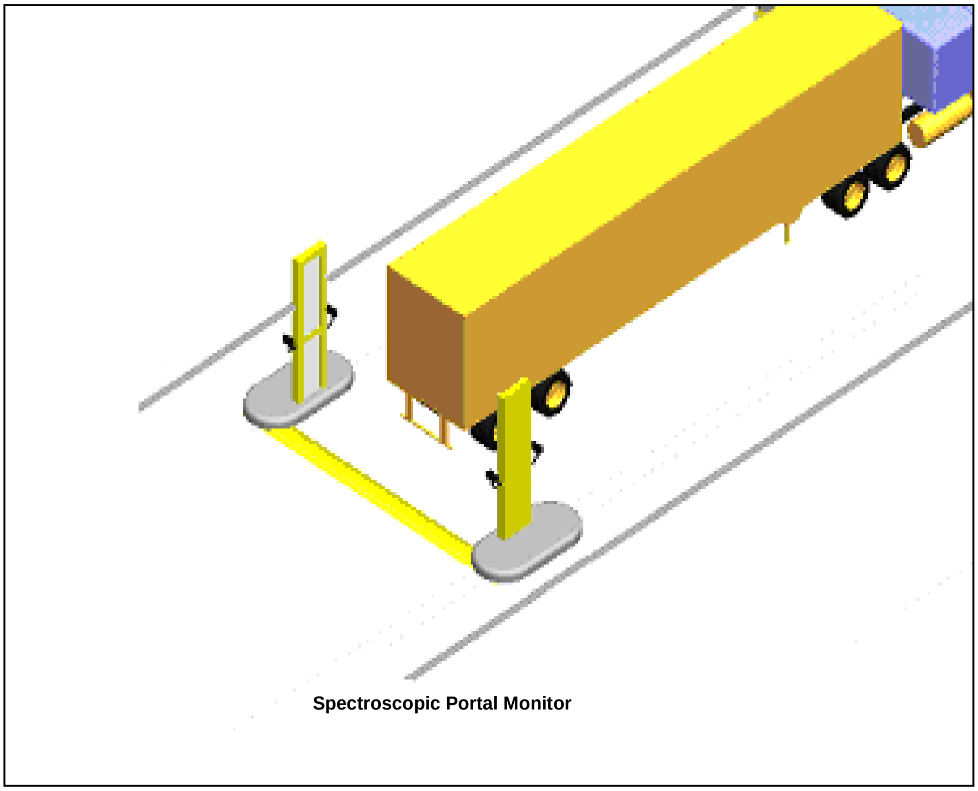

Figure 1-1. Notional View of ASP Deployment

1.2 General Discussion

The ASP System conceptually consists of two major elements: (1) Portal Monitor and (2) Remote Station. The **Portal Monitor** element measures and analyzes radiation, compares the results with alarm criteria, produces an alarm if the measured radiation exceeds the criteria, and provides the alarm indication to appropriate staff. The second element is the **Remote Station** that collects data from the Portal Monitors and other system components such as the Vehicle Identification System. The Remote Station presents alarm information to the supervisory personnel, archives the data locally and/or remotely, and can control the operational settings of the Portal Monitor. The conceptual architecture is illustrated in Figure 1-2.

The narrative description in this Section is provided as an aid and should not be (1) considered as requirements or (2) constraining on ASP designs.

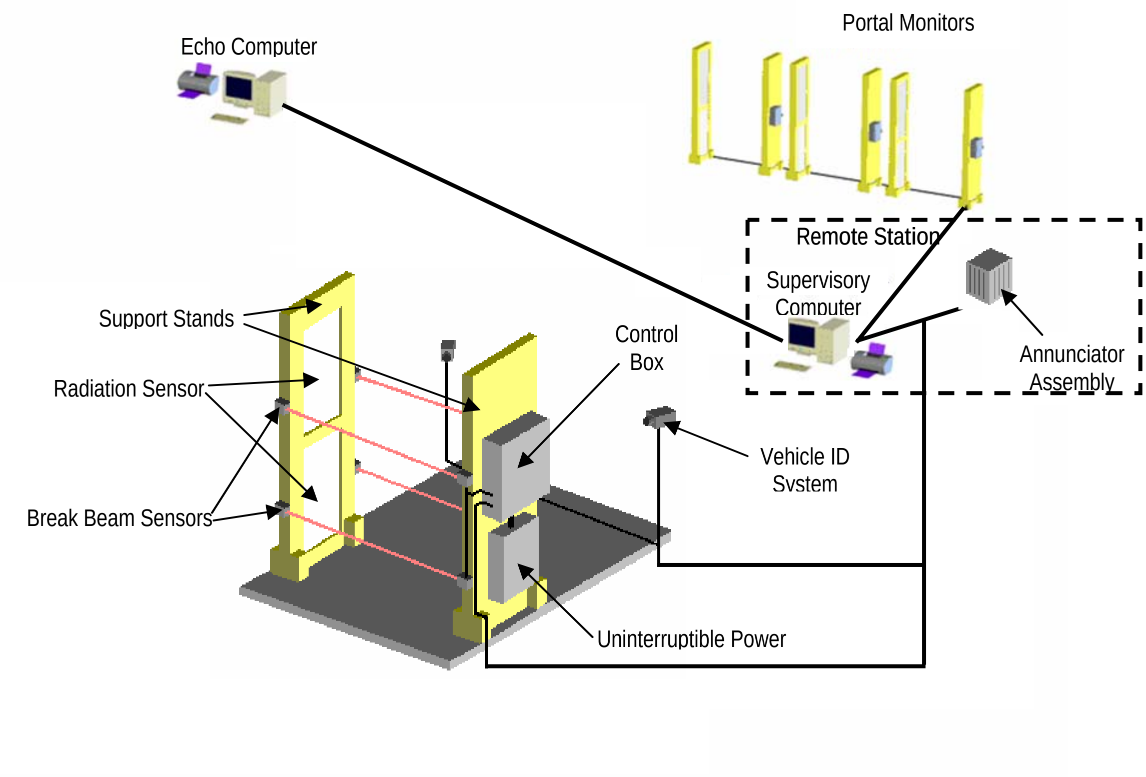

Figure 1-2. Conceptual Component Level Example of a Portal Monitor in a Standard Cargo Vehicle Configuration

1.2.1 Portal Monitor Architecture

The Portal Monitor is modular in construction at both the Radiation Sensor Panel level and within the Radiation Sensor Panels. The Portal Monitor is comprised of the components described below.

1.2.1.1 Radiation Sensor Panels

A Portal Monitor may contain two or more Radiation Sensor Panels, hereafter referred to as Panels, configured for a specific application. Each ASP Panel is identical in design to support modular assemblies. Panels are combined as building blocks to form a plane defined as the “detection assembly.” Detection assemblies are usually set up as opposing parallel planes defined to form the “detection system.” The following detection systems are currently deployed:

- Privately Owned Vehicle configured Portal Monitors typically consisting of one Panel set up on each side of a lane.
- Standard Cargo Vehicle configured Portal Monitors consisting of Panels typically stacked two-high, and at times two- or three-wide, for a total of 2 to 6 Panels on each side of a lane.
- Rail configured Portal Monitors consisting of Panels typically stacked three-high and two-wide on each side of a track.

The prototype ASP systems described in this document refer only to the Standard Cargo Vehicle configuration.

The general philosophy for detection systems is to provide approximately uniform sensitivity for the measurement of possibly shielded radioactive sources over the entire “detection zone”, as defined by ANSI Standard N42.38. Each Panel typically contains the following components:

1.2.1.1.1 Environmental Enclosure

An Environmental Enclosure provides a protective encasement for all sensitive detectors and electronics components of the Panel. The front Panel or door is designed to minimize attenuation of low-energy gamma rays. The internal mechanical mounting provides shock protection for the enclosed detection components. The interface between the Panel enclosure and the structural supports is described in Section 2.

1.2.1.1.2 Gamma Detector

Gamma Detectors are located within the Environmental Enclosure. The Gamma Detectors generate pulse-height-proportional electronic signals in response to the deposited energy of the incident gamma radiation. This signal is routed to the Panel’s Electronics Package. For the Advanced Spectroscopic Portal, Panels would likely contain multiple Gamma Detectors.

1.2.1.1.3 Gamma-ray Detector Shield

Shielding is placed around the Gamma-ray Detectors to reduce the background radiation entering the detectors from any direction other than the front of the Panel. Shielding is designed to enhance the signal-to-noise ratio for spectral regions of interest.

1.2.1.1.4 Neutron Detector

Each Panel contains one or more Neutron Detectors that generate electronic signals in response to neutron radiation. This signal is routed to the Panel’s Electronics Package. Technical requirements for Neutron Detectors are in Section 2. ^{3}He detectors have been widely deployed and experience indicates that ^{3}He detectors are relatively immune to count rate changes induced by strong gamma sources. However, other neutron detectors may be considered.

1.2.1.1.5 Neutron Moderator

Neutron detection requirements are described in Section 2. Where appropriate, neutron detectors are surrounded by polyethylene to moderate high-energy neutrons from the inspected vehicle or container.

1.2.1.1.6 Electronics Package

An Electronics Package within the Panel provides power to the detectors, processes the signals from the detectors, and provides data to the Portal Computer.

1.2.1.2 Support Structure

The Support Structure(s) aligns one or more Panels to establish a detection assembly, orients the Panels, provides physical protection for the Panels, and provides additional radiation shielding to the Panels. Modularity in the design of the Support Structure allows for specialized deployments and the combining of Support Structures for configurations requiring multiple detection systems.

Foundations are designed to support the Portal Monitor. Support Structures are mounted to these foundations to provide structural support and orientation control for each Panel.

For existing deployments, standard interconnection points are specified for mounting Support Structures, and their associated Panels, side-by-side and on top of each other to form a detection assembly plane.

The Support Structures also provide mounting surfaces to align and support other Portal Monitor components.

1.2.1.3 Detection Zone Occupancy and Speed Sensors

Occupancy Sensors are used to detect the presence, location and speed of objects in the detection zone. Occupancy Sensors generate signals when a vehicle enters and exits a detection zone, and provide a means to calculate vehicle speed. The signals are also used to identify when a vehicle has stopped within the detection zone.

When an Occupancy Sensor is activated by a vehicle, the Portal Monitor surveys radiation until the vehicle traverses the detection zone. Several types of sensor arrays, such as optical break-beams and inductive loops, may be used to accommodate the wide range of field conditions. Break-beam type sensors are used for the ASP prototypes.

1.2.1.4 Ancillary Sensors

Ancillary Sensors can be used to provide extra vehicle information for intelligent alarm algorithms (vendor supplied or future capability). Provisions for ancillary sensors are made in the data stream.

1.2.1.5 Annunciator Assembly

The Annunciator Assembly is the primary user interface providing the operator with alarms and Portal Monitor status indicators and is the only mechanism used to reset alarms. For the ASP prototypes an Interior Annunciator Assembly will be part of the Remote Station.

1.2.1.6 Control Box

The Portal Monitor Control Box is usually mounted directly on the Support Structure, but may be mounted in a remote location to facilitate deployment. The Control Box contains the Portal Computer. The Control Box also provides signals and data to the Annunciator Assemblies, Remote Station (refer to Section 2.2), and other interfacing systems, such as traffic control devices where such systems are employed.

1.2.1.6.1 Portal Computer

The Portal Computer, the primary computer, is mounted in the Control Box to run application software capable of operating the Portal Monitor independent of the Remote Station. This computer processes the signals from the Radiation Sensor Panels, Occupancy Sensors and Ancillary Sensors, and correlates this information into vehicle and background survey data. This computer also monitors the performance of the Portal Monitor to identify system or measurement errors. This computer evaluates data from the surveys and monitoring routines to provide radiation alarms and the Portal Monitor status to the Annunciator Assembly.

The Portal Computer is networked with a Supervisory Computer within the Remote Station to exchange information. The monitoring system functions are accomplished jointly between software applications on these two computers, however monitoring system criteria required for continuous operations are completely accomplished by the Portal Computer.

1.2.1.6.2 Portal Computer Interfaces

Electronic interfaces are specified to provide signals to components that may be provided by others. Examples include other related systems, such as conveyance control systems (lane traffic control signals) and imaging systems.

1.2.1.7 Uninterruptible Power Supply for Portal Monitor

An Uninterruptible Power Supply (UPS) provides a continuous source of power to the Portal Monitor and provides power conditioning to protect against transients. This component minimizes the impact of short duration power outages on Portal Monitor operations. Some portals may use sufficient power to require use of a standby generator.

1.2.1.8 Interconnecting Hardware/Cabling

Cabling and hardware within defined interfaces are only specified when the specification facilitates deployment or maintenance. Any external cabling includes appropriate shielding so that the unit meets the RF susceptibility tests specified herein.

1.2.1.9 Vehicle Identification System (VIS)

The VIS is used to create an image of a vehicle in order to associate that image with the physical object generating the radiation signature (both alarming and non-alarming). The key components of the VIS are high resolution cameras for capturing images of vehicles and cargo. In addition, the VIS is integrated into the Portal Monitor and networked into the Remote Station.

1.2.2 Remote Station Architecture

The Remote Station Architecture includes one Supervisory Computer, an Echo Computer, Uninterruptible Power Supplies, Computer Monitors and Printers. The Remote Station is typically separated from the Portal Monitors and sited in an indoor location overlooking the inspection area. The Remote Station comprises the following components.

1.2.2.1 Supervisory Computer

For the ASP prototypes, the Supervisory Computer and peripherals will be supplied by the Offeror. The Supervisory Computer includes application software to communicate with the Portal Monitor and provide the status of each Portal Monitor to DHS personnel.

The Supervisory Computer is also used to upload software and change parameters within the Portal Computer. This approach minimizes the need for computer peripherals within each Portal Monitor Control Box and the need to physically exchange any firmware.

The Supervisory Computer provides normal and alarm status information to Echo Computer(s), which are located remotely from the Supervisory Computer and repeat all the information presented on the Supervisory Computer.

Supervisory Computer peripherals include a display monitor and color printer. The Portal Monitor application software provides specified displays and hard-copy data through these devices.

The specifications for this computer and the associated operating system are provided in Section 2 to facilitate the development of the application software.

1.2.2.2 Echo Computer

Echo Computers are similar to the Supervisory Computer, but are only used to display information with no control or archiving function. The ASP prototype will include one (1) Echo computer supplied by Offeror.

1.2.2.3 Uninterruptible Power Supply (UPS) for Remote Station

The ASP prototype includes a UPS separate from the Portal Monitor power supplies. This component minimizes the impact of short duration power outages on the Supervisory Computer and printers.

1.3 Definitions

The following definitions apply to this specification. Additionally, the definitions provided in ANSI N42.35-2004 and ANSI N42.38-WD-F1a (Draft) apply to this specification and are not repeated here unless alternate definitions are provided below.

Baseline Depression

Baseline depression occurs whenever a vehicle occupies the Portal Monitor and blocks the surrounding environmental gamma radiation. The baseline may typically drop by 25% from the background value seen between vehicles when the portal is occupied by a truck. Baseline depression ranges from no effect to as much as a 50% reduction from the background value between vehicles and has a significant influence on detection probability.

Control and Analysis Software

The control and analysis software (CAS) is the application software package residing on the Supervisory Computer and in the Control Box of each Portal Monitor.

Alarm Algorithms:

Gross Count Rate Algorithm

Gross count rate alarm algorithms alarm are based on the gross gamma or neutron count rates versus background count rates. These algorithms may use temporal correlations to enhance sensitivity to localized sources. Also, different criteria may be applied to individual detectors versus the cumulative count rates for portal systems employing multiple detectors. For example, neutron data are handled by a gross counting algorithm.

Energy-Based Alarm Algorithm

An energy-based alarm algorithm uses portions of the gamma spectrum or ratios of count rates within selected energy regions to discriminate between naturally occurring radioactive material (NORM), RDDs, SNM, and medical and industrial isotope products.

Isotope Identification-Based Alarm Algorithm

Systems using isotope identification algorithms issue alarms based on isotope identifications, which may be performed using either peak-search, full-spectrum analysis or other methods.

Temporal-Filter-Based Alarm Algorithm

A temporal-filter-based alarming algorithm uses the spatial profile of the gamma gross count or energy-window count to distinguish between a point source and a distributed source.

Threat-Based Alarm Algorithm

A threat-based alarming algorithm combines criteria from the above approaches, and is derived from calculated or measured features of materials (SNM) and objects (nuclear devices or RDDs) of concern. The alarm criteria may include any or all of the following characteristics: identified isotopes; confidence in the isotope identifications; estimates of isotope quantities; the gross gamma count rate; the gross neutron count rate; the cumulative threat associated with combinations of isotopes that are deemed to be suspicious. A simple example of combined criteria might be automatic dismissing of a modest gross count alarm, if fully explained by NORM spectral features.

Innocent Alarm

An innocent alarm is an alarm state produced by conditions defined by the user to over-ride specified gamma alarm states. For example, an innocent alarm state exists if a threshold alarm occurs but is identified as NORM and the user has set the conditions to not produce an alarm notification. Innocent alarms are also known as “false alarms” and “nuisance alarms.”

Lane

A lane is defined to be the path a single target vehicle follows through a port of entry. Multiple lanes exist at most ports of entry. Lanes are generally parallel and in close proximity to one another.

NORM

NORM refers to naturally occurring radioactive material. It is a regular part of commerce, and thus a potential source of innocent alarms. Since the environmental background is largely produced by NORM, both background spectra and spectra blocked by baseline depression have features similar to a thick NORM source.

2.0 STANDARDS AND REQUIREMENTS

2.1 Standards

2.1.1 ANSI N42.38-WD-F1a (Draft)

Advanced Spectroscopic Portals shall meet all specifications of ANSI N42.38-WD-F1a (Draft), except when this Performance Specification provides additional requirements. In the case of conflict, this Performance Specification takes precedence over the conflicting requirement in the ANSI standards. Where ranges of test conditions overlap, the maximum of the combination should be used (e.g., if one temperature range is –30 ºC to +55 ºC, and the other is –40 ºC to +50 ºC, the range required is then –40 ºC to +55 ºC).

2.2 Design Requirements

2.2.1 General Characteristics

Section 2.2 describes the basic Portal Monitor performance and design requirements, including gross-count operation of the gamma ray and neutron systems, while the Section 2.3 describes the performance requirements for isotopic identification.

These Portal Monitors are classified as ANSI N42.38-WD-F1a (Draft), Vehicle (including road transported containers) monitors.

2.2.1.1 Detection Zone

Portal Monitors shall meet the performance requirements for detection of radioactive sources over the entire spatial region of interest (horizontally and vertically). The following requirements are specified in addition to the general characteristics specified in ANSI N42.38-WD-F1a (Draft).

2.2.1.1.1 Standard Cargo Vehicle Detection Zone

The terms “Vehicle (includes road transported containers)” and “Standard Cargo Vehicles” are used interchangeably.

Panel (s) shall be deployed on each side of a lane for a cargo deployment. The distance between Panels (lane width) shall be 5.0 m (16.4 ft).

2.2.2 Configuration

The following requirements are specified in addition to the configuration requirements specified in ANSI N42.38-WD-F1a (Draft).

2.2.2.1 Radiation Sensor Panel Configuration

2.2.2.1.1 Environmental Enclosure Configuration

a. Enclosures shall be configured to preclude accidental or malicious access, use, modification, or destruction. Enclosures shall be lockable.

b. All interior components shall be mounted with positive support in both the horizontal and vertical directions. Components shall be mounted and isolated to protect them from damage or degradation due to mechanical shock.

c. Interior component supporting braces shall not rely solely on friction to avoid slippage when mounted in any orientation.

d. If scintillators with photomultiplier tubes are used, the photomultiplier tubes shall be firmly mounted to the scintillator with a mechanism (e.g., springs) to maintain pressure and reduce the potential for decoupling.

e. Any diagnostics connector and cover shall be located to allow easy access while the Radiation Sensor Panel is mounted to the Support Structure.

f. The closure must be hinged and/or removable with a minimal number of fasteners or latches. Fasteners, if used, shall be captive.

g. Quick-acting fasteners or latches are preferred.

h. A pressure-equalization vent or other device shall compensate for pressure differential between the enclosure and the ambient atmosphere.

i. Passive corrosion protection shall be used to protect metal, e.g., aluminum and steel, surfaces.

j. Panels shall be constructed:

- Of materials that do not contribute significantly to the gamma-ray background rate (e.g., no fiber glass that is rich in thorium-chain radionuclides);
- Of materials with a low neutron-capture cross section (e.g., no cadmium plating);
- On the back and sides with aluminum or stainless steel that is at least 2.0 mm (0.078 in.) thick;
- On the front side (facing the traffic lane) with aluminum that does not exceed a thickness of 2.0 mm (0.078 in.);
- In a properly sealed and mechanically robust manner, e.g., all-welded aluminum or stainless steel construction.

k. If components are used that are subject to thermal shock, the Panels shall be insulated to prevent detectors from fracturing due to rapid temperature changes. The insulation shall limit the rate of change of the detector temperature to less than the maximum recommended by the detector manufacturer or 5ºC/hr, whichever is less.

l. The components and enclosure must be designed such that the detectors will not be damaged by rapid (greater than 5ºC/hr) temperature changes during periods when the front of the Panel is open (e.g., during maintenance).

m. The Panels shall be recessed from the front into the Support Structure by at least 2.54 cm (1.0 in.), so that the Support Structure steel protects the detector from physical damage.

n. Panels shall be mounted to the Support Structure in a secure manner. For interchangeability, it is desirable that the Panel mount to the Support Structure per Interface Definition 04 in Section 5.

2.2.2.1.2 Gamma Detector Properties

Commercially available Gamma Detectors meeting the following criteria shall be used:

a. Each photomultiplier tube used (if any) shall have an independent amplifier and lower level discriminator to eliminate electronic noise and facilitate gain balancing;

b. Analog signals from the photomultiplier tubes and preamplifiers (if used) shall be transmitted on coaxial wire and not superimposed on the same wire as any high voltage;

c. The detector shall be responsive to incident gamma radiation in the energy range 25 keV to 3000 keV;

d. Gamma detectors shall be designed to be interchangeable.

2.2.2.1.3 Gamma Detector Shielding

The Gamma Detector Shielding design is left to the Offeror subject to the following minimum requirements:

The individual gamma detectors shall be shielded on the back, sides, top and bottom with:

a. A layer of lead or other material that provides at least as much attenuation as 0.64 cm (0.25-inch) of lead at 511 keV.

b. A graded filter between the outer shield and detector to absorb x-rays if high-Z shielding material is used near the detector.

c. Cadmium or other high neutron capture material in the vicinity of the neutron sensors shall be avoided.

2.2.2.1.4 Panel Electronics Package

2.2.2.1.4.1 Gamma Detector Electronics

a. All gamma counters shall include nearly identical counting intervals. The gamma ray spectra shall be simultaneously transferred to buffers at the conclusion of each 0.1-second counting interval (i.e., the maximum starting time dispersion shall be less than 2 μs (microsecond)), without the loss of new counts arriving during the transfer time (i.e., the counters shall be buffered with less than 10 μs (microsecond) required to make a parallel data transfer and restart counting).

b. Gamma counters shall be designed to avoid double counting events.

c. Gamma gross-count and energy-window counters shall not rollover, but rather saturate to a maximum count value. Any MCA-based system shall have a provision that removes high count rate ambiguities resulting from potential MCA channel rollover (i.e., positive indication or sufficient counter range).

d. Signals from each detector shall be processed independently to obtain spectra with at least 512 channels approximately linearly distributed over the energy range 25 keV to 3000 keV. Any signal above 3000 keV shall be placed into an overflow channel. If an energy range greater than 25 keV to 3000 keV is provided, the number of channels shall be adequate to provide equivalent energy resolution as above and any signal above the maximum range shall be placed in an overflow channel. If the sensor resolution is greater than that of NaI(Tl), adequate resolution (e.g., no peak less than 4 channels wide) for the sensor shall be provided.

e. Automatic gain and offset stabilization of spectra from each individual detector shall be provided, if appropriate for the detector design. The peak resolution of both low and high energy peaks shall not be degraded due to thermal or other energy calibration drifts.

f. Gain-stabilized and energy-aligned spectra from individual detectors shall be summed to obtain a composite spectrum of at least 512 channels for the Panel.

g. The energy resolution of the composite Panel spectrum shall be 8.7% peak full width at half maximum (FWHM), or better, at 662 keV. Energy resolution is the FWHM divided by the peak position.

h. The multi channel analyzer subsystem shall be capable of handling count rates up to 50,000 counts per second per detector module with a dead-time of no more than 10%.

i. A dead-time correction shall be provided and indicated with the data.

2.2.2.1.4.2 Neutron Detector Electronics

a. Independent neutron counters shall be supplied and recorded for each neutron detector.

b. Provisions shall be included to avoid double counting events.

c. All neutron counters shall not rollover, but rather saturate to a maximum count value.

d. All neutron counters shall count identical time intervals (i.e., the maximum starting time dispersion shall be less than 2 μs) with an minimal dead time between counting intervals (i.e., the counters shall be buffered with less than 10 μs required to make a parallel data transfer and start recounting).

e. An alarm algorithm user option shall be included that can suppress neutron alarms based on multiple counts in one neutron detector for only a single 0.1 second time period.

f. An alarm algorithm shall be provided that identifies all saturation or potential rollover conditions with a fault alarm.

2.2.2.1.4.3 Detector High Voltage Supplies

a. High voltage shall be generated within the Panel, rather than transmitting the high voltage from an external source.

b. Separate high voltage power supplies shall be used for each detector to prevent the propagation of voltage breakdown signals.

2.2.2.1.5 Radiation Sensor Panel Gross Counting Requirements

2.2.2.1.5.1 Gamma Gross Counting Capability

a. The ASP prototypes shall be designed with the following capability for detection based on gamma gross counting:

Provide at 95% or greater probability of detection (not necessarily identifing) for the sources listed in Table 2-1 under the following conditions:

1. Source shall be located at the midpoint of the detection zone (i.e., 2.5 m from the Panels and 2.25 m above ground level);
2. Source shall be bare (unshielded) and a point source
3. Source shall be moving at 5 mph (+/- 10%);
4. Assumed radiation background rate is 5 microR/hr;
5. Assumed radiation background suppression is 25%;
6. Gross counting alarm threshold shall be set with a statistical false alarm rate of < 0.1%.

Radionuclide	Activity (μCi)
^{241}Am	24
^{57}Co	5
^{133}Ba	3
^{137}Cs	5
^{60}Co	3

Table 2-1. Source Activities for Gamma Gross Counting Capability

2.2.2.1.5.2 Neutron Gross Counting Capability

Portal Monitors shall have a 95% or greater probability of detection (not necessarily identify) for a ^{252}Cf neutron source with an emission rate of 2x10^4 neutron/second under the following conditions:

a. Source shall be located at the midpoint of the detection zone (i.e., 2.5 m from the Panels and 2.25 m above ground level);
b. Source shall be moving at 5 mph (+/- 10%);
c. Source shall be:
  (1) a sealed point source, but bare (assume 1 cm steel encapsulation);
  (2) shielded with 0.5 cm thick lead and 2.5 cm thick polyethylene;
d. Gross counting alarm threshold shall be set with a false alarm rate of < 0.1%.

2.2.2.2 Support Structure Configuration

Support Structures house Panels and provide structural support for the Portal Monitor equipment. In the existing Standard Cargo Vehicle configuration, an individual Support Structure accomplishes this function. This Support Structure provides impact protection for the detectors as well as additional gamma shielding.

2.2.2.2.1 Standard Cargo Vehicle Support Structure Configuration

Support Structures are one element of modularity to meet deployment requirements. Each Support Structure houses a Radiation Sensor Panel. In existing deployments for the Standard Cargo Vehicle configuration, two “Support Stands” are stacked two-high on opposite sides of a lane.

a. The Radiation Detection Panels shall fit within the physical envelope of the Support Structure of the existing deployed systems as closely as possible. Existing Standard Cargo Vehicle deployments use 2 each “Support Stands” per Figure 5-1 resulting in a physical envelope for the Radiation Detection Panels of 38 inches wide x 16.25 inches deep x 189.5 inches tall. It is desirable, but not required, for the ASP prototypes, to fit within the physical dimensions shown in Figure 5-1 and employ the same mounting features.

b. Support Structures shall be constructed of steel of at least 1.27 cm (0.5 inch) thickness on the sides, bottom and top, and 2.54 cm (1.0 inch) on the back covering the entire area of the Panels or materials and design providing equivalent shielding and mechanical support.

c. The bottom, top, sides and back of the Support Structure shall be manufactured and assembled in a robust manner. For example, steel should be welded using 0.1250 in. minimum fillet welds, and meet the welding qualifications and fabrication standards for carbon steel per the American Welding Standard (AWS) D1.1-2002. Note: Welding rods shall not contain thorium.

d. Where Support Stands are bolted together, the bolt patterns for interconnection are described in Interface Definition 09 of Section 5.

e. Whether mounted as one individual Support Structure or interconnected as a set of 2 (2-high) Support Stands, the entire Portal Monitor shall sustain the structural load imposed when all equipment is mounted, including: Panels, Shielding, Control Box, Battery box, interconnecting Support Structures, Occupancy and Ancillary Sensor equipment, and associated cabling and hardware.

f. The Panels shall be recessed from the front into the Supports Structures by at least 2.54 cm (1.0 in.) so that the steel protects the detector from physical damage and provides some field-of-view collimation for the gamma detectors.

g. Support Structures shall support the Panels with the long axis in the vertical direction.

h. Where practical, Support structures should be designed to comply with Interface Definitions 04, 05, 06, 07, 08, 09 and –10 of Section 5.

2.2.2.3 Occupancy and Speed Sensor Configuration

a. Sensors shall detect a vehicle entering the Portal Monitor detection zone.

b. Sensors shall detect a vehicle exiting the Portal Monitor detection zone.

c. Sensors shall be placed and have sufficiently sensitive to detect unloaded vehicles and extension reaches used with truck and pup combinations.

d. Sensors shall measure the vehicle speed with a minimum of 10% precision.

e. The Occupancy Sensor signal to the Control Box shall meet Interface Definition 02 of Section 5.

f. The ASP prototype shall be designed to be capable of supporting the following types of sensors:

   - Break-beam type
   - Inductive loop type.

g. For the ASP prototypes, the Offeror shall provide break-beam type sensors.

h. Break-beam type sensors shall be mounted as redundant pairs at different heights for the Standard Cargo Vehicle configuration in order to guarantee that entry and exit are detected for all possible vehicle types transiting the portal. Data for each pair shall be separately stored.

i. Occupancy Sensors shall be compatible with deployed Support Structure separations.

j. Where practical, Break-beam type Occupancy Sensors shall mount to the Support Structure according to the bolt pattern provided in Interface Definition 05 of Section 5.

k. The mounting shall prevent misalignment caused by accidental human or vehicle contact.

2.2.2.4 Ancillary Sensor Configuration

Intelligent alarm algorithms (vendor provided or future) can make beneficial use of additional information such as knowing the vehicle type and the vehicle offset form the Portal Monitor centerline.

a. Two additional 8-bit digital data ports shall be provided for as yet unspecified ancillary sensors. Offerors are free to use these extra data ports for ancillary data that their algorithms may require.

b. Ancillary data shall be stored at 0.1 second intervals.

2.2.2.5 Annunciator Assembly Configuration

a. ASP prototype systems shall include at least one (1) Interior-type Annunciator Assembly to be located in the Remote Station.

b. ASP prototype systems shall be designed to be capable of providing interfaces for up to 5 additional Annunciator Assemblies.

c. ASP prototype systems shall be designed to be capable of accommodating the power requirements associated with the additional 5 Annunciator Assemblies.

d. Annunciator Assembly shall be hardwired to the Portal Monitor for distances of up to 100 meters.

e. All power for the Annunciator Assembly shall come from the Portal Monitor. No external source of power is permitted.

f. A single cable shall be used for both communications and power between the Portal Computer and the Annunciator Assembly. Data format shall be Transmission Control Protocol (TCP) over Ethernet, or RS 485 over Ethernet. The Annunciator shall indicate any loss of communications.

2.2.2.5.1 Interior Annunciator Assembly Configuration

a. The Interior Annunciator Assembly shall be as small as practicable. Existing systems have a footprint smaller than 30 cm x 10 cm x 10 cm.

b. All controls and indications shall be included on the front face of the enclosure.

c. Mounting instructions and a drawing of the mounting bolt pattern shall be provided in the installation instructions.

2.2.2.6 Control Box Configuration

The elements of the Control Box shall be tolerant of highly damp conditions, such as those encountered when opening the Enclosure during periods of very high or condensing humidity, snow storms, rain storms, or other inclement weather.

2.2.2.6.1 Control Box Enclosure

A Control Box Enclosure meeting the following requirements shall be provided:

a. Shall be NEMA 4X rated (preferred) or capable of meeting the requirements for NEMA 4X;

b. Shall be configured to preclude accidental or malicious access, use, modification, or destruction;

c. Shall be designed to be capable of providing penetrations for routing of up to three Category 5 (CAT 5) cables;

d. Shall be lockable and include an electronic log indication of each entry event;

e. Shall be hinged;

f. Fasteners, if used, shall be captive;

g. Quick-acting fasteners or latches are preferred;

h. Shall include a pressure-equalization vent or other device to compensate for pressure differentials between the case and ambient atmosphere.

i. Shall be as small as practicable. Existing systems are no larger than 38.1 cm (15.0 in.) wide by 45.7 cm (18.0 in.) high by 25.4 cm (10.0 in.) deep.

2.2.2.6.2 Portal Computer

a. The Portal Computer shall be located in the Control Box.

b. The Portal Computer shall be designed to be capable of providing three Transistor-Transistor Logic (TTL) RJ-45 connection points in the Control Box to provide the Portal Computer with the capability for interfacing with port systems, such as traffic controllers, and imaging equipment.

2.2.2.7 Uninterruptible Power Supply (UPS) Configuration for Portal Monitor

2.2.2.7.1 Uninterruptible Power Supply Enclosure

If a separate enclosure is supplied, the UPS enclosure shall be as small as practicable and capable of being mounted on the Support Structure. Existing systems are no larger than 43.2 cm (17.0 in.) wide by 45.7 cm (18.0 in.) high by 45.7 cm (18.0 in.)..

2.2.2.8 Interconnecting Hardware/Cabling

Hardware and cabling among Portal Monitor components and interfaces shall be provided, including:

a. Hardware to mount Panels to Support Structures

b. Hardware to mount the Control Box to Support Structures

c. Hardware to mount Annunciator Assemblies

d. Mounting hardware for components within Panels and the Control Box

e. Cables, cable ties and wiring harnesses within and between all components and interfaces.

f. All exterior connections shall be marine grade weather resistant.

2.2.2.9 Vehicle Identification System (VIS)

2.2.2.9.1 Cameras and Images

a. The VIS shall provide clear and discrete images for each vehicle or container.
b. Up to three (3) high-resolution digital network-based imaging cameras shall be supported per lane of traffic.

- Minimum resolution of 1024 x 768 pixels
- Digital (no analog) camera-based image system
- Fixed focus, auto-iris lens
- Front and rear views for all vehicles; side views showing full cab of commercial vehicles for cargo lanes

c. Cameras shall be housed in environmental enclosures appropriate to local conditions
d. VIS components shall operate in ambient temperatures from -40º C to +55º C and ambient relative humidity up to 100%

2.2.2.9.2 VIS Network

a. The VIS cameras shall be triggered externally by the Occupancy Sensors
b. The VIS shall communicate with the Supervisory Computer (in the Remote Station) via an Ethernet connection using TCP/IP protocol.
c. The communications network shall operate at 100 Mb/s or faster using network interfaces compatible with 100Base-F/100Base-T networking equipment.

2.2.3 Indications and Controls

The following design features are specified in addition to the indication features specified in ANSI N42.38-WD-F1a (Draft).

2.2.3.1 Portal Computer Indications and Controls

2.2.3.1.1 Portal Computer Access

The Portal Computer shall be accessible through a network interface to allow:

a. An external data processor, such as the Supervisory Computer, access to the Portal Monitor gamma, neutron, vehicle data, and Uninterruptible Power Supply performance;
b. A user to configure the Portal Monitor remotely, including all parameters and replacement of Portal Computer software; and

Local control and parameter access shall also be possible at the Control Box.

2.2.3.1.2 Portal Computer Outputs for External Devices

An interface between the Portal Computer and external devices such as traffic controllers and imaging equipment shall be provided according to Interface Definition 02b of Section 5. This interface will be implemented in the ASP prototypes only insofar as required to support ASP external devices (e.g., VIS).

2.2.3.2 Portal Computer Hardware

The Portal Computer hardware shall meet the following specifications and be capable of supporting additional and advanced software for alarm algorithms supplied by others. The Portal Computer shall include sufficient spare memory and processing capacity to handle twice the initial memory and processing loads.

2.2.3.3 Portal Monitor Computer Application Software (CAS)

The Portal Monitor CAS shall meet the following specifications.

a. Designed to be capable of accommodating up to 12 Radiation Sensor Panels working in a detection system.
b. Operate, store, and evaluate the results from each individual Radiation Sensor Panel.

c. Buffer locally, for potential transmission to the Supervisory Computer, all data for up to 100 vehicle passages at standard vehicle speed (5 mph).

d. Communication with the Supervisory Computer via TCP/IP (Transmission Control Protocol/Internet Protocol) is preferred.

e. UDP/IP (User Datagram Protocol/Internet Protocol) shall not be used for any communication on the network between the Control Box and devices external to the Portal Monitor, including the Supervisory or Echoing computers. UDP/IP shall not be used elsewhere except for synchronization (i.e., not for any data or alarm related information exchange).

f. Two levels of password protection shall be provided for parameter settings.

g. Designed to be capable of allowing a user to configure the Radiation Sensor Panels, vehicle Occupancy Sensors and Ancillary Sensors.

h. Complete and acknowledge a user-initiated configuration change with a stored change log.

i. Accept and execute commands programmatically generated and transmitted by the Supervisory Computer within 1 second. Any changes in portal configuration shall be queued within 1 second, but changes shall not occur during vehicle occupancy or during transmission of a vehicle's data records.

j. Accept and store parameters in non-volatile memory.

k. Automatically boot-up after power loss and restoration.

l. Complete boot-up and initialization and start collecting, processing, and transmitting data within 1 minute of power-up.

m. Determine and analyze the Panel composite spectra, at least one of which shall cover the entire vehicle occupancy and another shall cover only the region of maximum gross-count (e.g., using the FWHM of any significant spatial peaks).

n. Process the counts from the neutron-detection-module signal and the gamma detectors and process the occupancy and possibly speed of a vehicle at a sampling period of 0.1 seconds. Be capable of averaging time samples for an adjustable time interval up to 10 seconds.

o. Collect all Portal Monitor data (spectra from each detector in a Panel, background data, neutron counts, alarm conditions) each of 0.1 seconds. Be capable of averaging time samples for an adjustable time interval up to 10 seconds.

p. Provide alarm notification within 2 seconds of alarm detection.

q. Under routine operations, combine, format, and transmit all Portal Monitor data to the Supervisory Computer within 1 second.

r. Transmit raw data to the Supervisory Computer as 0.1 second count values. This capability shall be user selected to achieve two transmitting periods, including: 1) vehicle is present, and 2) vehicle is not present.

s. For each vehicle, the raw data to be recorded and transmitted includes all independent radiation counter and vehicle sensing information without consolidation or pre-processing. Between vehicles, the raw data can be consolidated according to user settable parameters.

t. Transmit raw data when triggered to the Supervisory Computer as 0.1 second count values including at least 5 seconds prior (user settable) to each vehicle (pre-samples) and at least 2 seconds subsequent (user settable) to each vehicle (post-samples).

u. Transmit raw spectral data to the Supervisory Computer at a user specified time covering a user specified time interval (spectral snapshot).

v. Meet all performance requirements while simultaneously servicing remote accesses by the Supervisory Computer.

w. Run independently of the Supervisory Computer.

x. Be able to process radiation, occupancy/speed and ancillary sensor data whether or not the Supervisory Computer is available to accept the information.

y. Be able to upload software and change parameters via a local-area network, typically from the Supervisory Computer. Any changes in portal configuration shall not occur during vehicle occupancy or during transmission of a vehicle's data records.

z. Handle background collection for both neutrons and gamma as described in Section 2.2.3.3.2

2.2.3.3.1 Portal Monitor Computer Data Format

The Portal Computer shall be capable of transmitting the raw data in such a manner that the Supervisory Computer can completely duplicate the processing in the Portal Monitor Computer and conduct alternate, more in depth, analysis on selected vehicles. The transmission shall include at least the following data, at a user-settable rate:

a. Portal Monitor identification;

b. The time values from the Portal Monitor Computer clock (the Supervisory Computer providing the master clock synchronization);

c. The gamma spectra and background for each gamma sensor element in the array with a module identification number (number, letter). The module identification number numerically identifies the detector and the Panel (e.g., A1, A2, …, An; B1, B2, …, Bn);

d. The neutron count and background or the counter or count-rate value for each neutron sensor element in the array from the neutron detector module;

e. The vehicle Occupancy Sensor data or the vehicle occupancy and speed sensor time information for each sensor and data from all Ancillary Sensors;

f. Mode parameter describing the current mode of operation. Valid mode values include at a minimum:

   - normal,
   - diagnostics,
   - calibration,
   - out-of-service, and
   - idle.

g. The format of the data stream shall:

   - Be an open format;
   - Not be proprietary or require proprietary software to read or interpret;

- Not use complex binary data file formats for unusual characters in text strings, unless they are readable by a common operating system utility, such as Microsoft® Access or Microsoft® Notepad.
- Binary spectral data files shall only use standard integer and floating point formats readily readable by common analysis programs (i.e., readable by FORTRAN or C++ codes).
- Not embed complex binary strings in data files or data files composed of databases; and
- Be fully and publicly disclosed in an appendix of the Maintenance Manual.

2.2.3.3.2 Portal Monitor Computer Background Computation

The Portal Monitor CAS shall calculate both gamma and neutron backgrounds (values when no vehicle is present) and automatically update that value using a user settable update period. The deployment of these systems *may* not provide the opportunity for an empty portal background measurement due to traffic flow. Therefore, the software shall be capable of estimating the between-vehicle background from measurements over previous time intervals during which no alarm condition existed. The software shall:

a. Avoid including measurements within ±2 seconds (user settable) of vehicle occupancy because of the depressed baseline;

b. Avoid including measurements occurring near any vehicle producing an alarm condition. Thus, inclusion into background shall be blocked for at least 30 seconds prior to two vehicles before any alarming vehicle and at least 30 seconds subsequent to two vehicles after any alarming vehicle subject to not blocking background collection for more than ±5 minutes of the alarm;

c. Be immune to slowly approaching sources, preventing background updates when background is changing too rapidly;

d. Store composite and individual detector background spectra on a regular time interval for potential later analysis.

e. The portal gamma background shall include full energy spectra as well as gross counts and energy window counts, if implemented.

f. The amount of time included in the background rates and spectra shall be user settable and shall allow up to 5 minutes of background data that can be piecewise collected over up to 30 minutes.

g. Initiate collection of a new average background spectrum on power up and/or user command.

2.2.3.3.3 Portal Monitor Computer Alarm Protocol

a. The Portal Computer application software shall establish alarm states based on information received from the Panels. Specifically, portals shall incorporate threat-based alarm criteria. The criteria **may** include any or all of the following characteristics: identified isotopes; confidence in the isotope identifications; estimates of isotope quantities; quality of peak or template fit (if applicable); the gross gamma count rate; the gross neutron count rate; and the cumulative threat associated with combinations of isotopes that are deemed to be suspicious.

Once an alarm state is reached, the software shall:

- Log the alarm state in the Portal Monitor log;
- Transmit the alarm state to the Annunciator Assembly using a hardwired, non-networked, connection;
- Transmit the alarm state to the Supervisory Computer using the network connection;
- Transmit (via the network) information for an alarm report and a complete set of raw data for that vehicle.

b. The Supervisory Computer shall have the capability to create an alarm state of any type by sending a message to the Portal Computer. The Portal Computer's response to these test alarms shall be the same as if the Portal Computer generated the alarm.

2.2.3.3.4 Adjusting Portal Monitor Computer Alarm Calculations

The Portal Monitor CAS shall:

a. Process detector readings to determine the portal alarm state and alarm type using alarm algorithms and user-provided alarm parameters;

b. Permit the uploading of new alarm algorithms through the Supervisory Computer;

c. Allow the user, via the appropriate protocol, to select from existing alarm parameters and algorithms that will be employed; and

d. Permit setting the alarm parameters without interfering with the on-going operation of the Portal Monitor – no setting of parameters while portal is occupied.

2.2.3.3.5 Portal Monitor Malfunctions

The Portal Monitor CAS shall monitor the performance of each Panel and detector within the Portal Monitor ("state-of-health" monitoring). The CAS shall:

a. Indicate whenever any alarm type cannot be processed due to invalid data or malfunction;

b. Issue an "outside-operational-limits" alarm whenever detectors are not operating within the user-defined limits. The out of limits alarm applies to individual detectors in each Panel to allow detection of faulty Panel subsystems;

c. Allow the user, via the appropriate protocol, to define the limits separately for neutron and gamma detectors. The lower-limit value for neutron background shall be settable with a resolution accounting for the normally very low background count rate;

d. Provide state-of-health self-diagnostics capability for each of the detectors used in the Portal Monitor;

e. Provide state-of-health self-diagnostics capability for each of the alarm indicators used in the Portal Monitor (e.g., discover and report any burned out light bulbs);

f. Operate normally if one or more detector subsystems fail, but with reduced sensitivity;

g. Provide indication of low battery when system is operating on UPS.

h. Provide an exterior method (light, meter, etc.) of determining if unit is on or off. However, exterior indications shall not be visible to surveyed vehicle or casual observer.

i. Be capable of providing an alarm, if no vehicle is seen for 10 minutes or user set interval.

j. Be capable of providing an alarm as a possible indication of dirty optics, if no vehicle is detected by the Occupancy Sensors but a baseline depression is measured.

k. Provide indication of all zero gross gamma counts in a 0.1-second intervals.

l. Provide indication of any lost 0.1-second data records.

m. Be capable of providing an alarm when Ancillary Sensors malfunction.

2.2.3.3.6 Portal Monitor Occupancy

The Portal Monitor CAS shall determine the vehicle count.

2.2.3.3.7 Portal Monitor Vehicle Speed Sensor

a. The Portal Computer application software shall determine the vehicle speed to within 10% over the potential range of vehicle speeds (e.g., nominal speed is 5 mph, but potential range is 2 to 30 mph).

b. The Portal Computer application software shall determine whether a vehicle has stopped during the occupancy and, if so, for how long.

2.2.3.3.8 Portal Monitor Ancillary Sensors

The Portal Monitor CAS shall process the data from any Ancillary Sensors.

2.2.3.4 Alarming Using Threshold-Based Alarm

a. The Portal Monitor CAS shall issue an alarm when it detects a gross radiation reading above a calculated threshold based on user set parameters.

b. Gross count alarm thresholds shall be settable simultaneously for individual detectors in a Panel, for the collection of detectors in a single Panel, for the sum of counts of all Panels on one side of a Portal Monitor, and for the sum of counts of all Panels in a Portal Monitor.

c. Application software shall be capable of automatically collecting and adjusting the value used for incident background radiation.

d. The alarm algorithm shall use a moving average of user settable duration.

e. The averaging period for alarm determination shall be adjustable up to 10 seconds. However, the minimum time interval shall be 0.1 second.

f. As a minimum, alarm thresholds for gross gamma and neutron counts shall be settable as a multiple of the background standard deviation value, or as an absolute number of counts per second (cps) above background using of the methods described in Appendix 2. Other methods for setting alarm thresholds can be provided as well.

2.2.3.5 Alarming Using Neutron Independent Detector Counting

The Portal Monitor CAS shall create neutron alarms with individual thresholds for each neutron detection module. The software shall also have the user selectable capability to reject multiple (“spike”) counts in a single neutron counter that occur in only one 0.1-s interval.

2.2.3.6 Alarming Using Isotope Identification-Based and Threat-Based Methods

The requirements for alarming based on isotope identification and threat-based methods are listed in Section 2.3.

2.2.3.7 Portal Computer “Watch Dog” Timer

The Control Box shall incorporate a circuit or method that:

a. Continuously monitors for signs that the Portal Computer has entered an indeterminate state or ‘”locked up’;”
b. Initiates a computer reboot if enabled by the user;
c. Logs the watchdog-induced reboot in an event log stored on the Supervisory Computer; and
d. Provides a fault notification to the Annunciator Assembly and to the Supervisory Computer.

In lieu of a watchdog timer, the Offeror may propose alternate methods to prevent or automatically recover from a ”lock up” condition.

2.2.3.8 Remote Health Monitoring of Hardware

The Portal Monitor CAS shall monitor the operational health and status of the Portal Moniotr and allow for remote interrogation of the same.. These parameters shall determine if the Portal Monitor characteristics have deviated from expected values. A minimum list of state-of-health parameters is:

a. Background gamma spectra
b. Current values of each high voltage supply
c. DC voltage levels
d. DC current consumption
e. Backup battery status
f. Ambient and internal temperature
g. Number of re-boots since midnight
h. Status of Occupancy, Speed and Ancillary Sensors
i. Time and date
j. Identification, such as lane number
k. Count rate above a lower level discriminator for each detector

l. Number of vehicles total since midnight

m. Number of alarms total since midnight

n. Error codes

o. Software revision

2.2.3.9 Supervisory Computer Indications and Controls

Application software shall be provided to configure the Supervisory Computer and Portal Computers. This software will monitor the Portal Computer and Radiation Sensor Panels; receive detector readings from the Panels; process these detector data to determine events, alarms, and the overall state of the Portal Monitor; calculate operating parameters based on detector data and user-provided parameters; log events and alarms; and store and retrieve data.

2.2.3.9.1 Supervisory Computer Hardware

A Supervisory Computer shall be provided with the following minimum hardware:

- PC-compatible computer, Dual Processor (2 CPUs), each CPU at 2.0 GHz;
- 1 Gigabyte of RAM;
- 100 Gigabyte Hard Drive;
- 10/100 Ethernet Network capability;
- DVD write-able drive;
- Mouse and keyboard;
- Sound capability;
- LCD monitor;
- Printer capable of printing color test sheet in less than 15 seconds; and
- Uninterruptible Power Supply.

2.2.3.9.2 Supervisory Computer Commercial Software

A Supervisory Computer shall be provided with the following commercial software:

- Microsoft® Windows® 2000 Operating System
- Roxio Easy Media Creator™ 7 Digital Media Suite.

2.2.3.9.3 Supervisory Computer Application Software (CAS)

Application software for the Supervisory Computer shall provide a graphical user interface to configure the Portal Computer, as well as provide for Portal Monitor operational control and oversight on a full-time basis. The application software shall:

a. Provide two levels of password protection for parameter settings;

b. Set all parameters associated with the alarm generation algorithms for each lane;

c. Maintain three sets of alarm settings (alert levels yellow, orange, and red) for each Portal Monitor;

d. Provide a simple method to switch all Portal Monitors in a system to one of these three designated security states;

e. Provide a lane (i.e., “Lane 1”), Panel (i.e., “Panel 1”), and detector (i.e., “Detector A”) designation method for each Portal Monitor;

f. Provide communications to dialogue between the Supervisory Computer and individual Portal Monitors;

g. Set the operating parameters for each Portal Monitor connected to the Supervisory Computer (i.e., detector operating parameters; vehicle sensor assignments—relationship of vehicle Occupancy, Speed sensors and Ancillary Sensor parameters, with lane location; the Panel’s TCP/IP address; etc.).

h. UDP/IP (User Datagram Protocol/Internet Protocol) shall not be used except for synchronization (i.e., not for any data or alarm related information exchange)

i. Execute software/parameter upgrades, on each Portal Monitor connected to the Supervisory Computer;

j. Establish logging parameters including frequency of health parameter logging, level of error logging, Portal Monitor boot-up event logging, and alarm logging;

k. Establish the frequency for creating new log files (i.e., a new log file is created every 24 hours, starting at 12:00 am);

l. Specify the storage location of the log file on the Supervisory Computer;

m. Use a non-proprietary, fully and publicly disclosed data format specified in the Maintenance manual;

n. Store raw non-alarm, alarm, spectral, and background data for 180 days (image data for a minimum of 10 days) for an assumed traffic load of 5000 vehicles per day (traveling at nominal speeds);

o. Display a standardized Status Panel on all its screens that indicates the operational status of the Supervisory Computer, all Portal Monitors, and all Annunciator Assemblies;

p. Indicate “Unknown” if the status information on a monitored component is not available.

q. Alarm the Status Panel when a scheduled activity either fails to complete on time or is unsuccessful;

r. Provide user navigation to any information item displayed on the Status Panel;

s. Display and automatically print (settable by the user) the temporal profile of the signal(s) (e.g., neutron counts gamma gross-counts and gamma counts over a user-specified energy windows, and the energy profile of the gamma radiation that produced an alarm) indicating the side of the vehicle, the position of maximum signal, and the isotope type in a user-friendly manner;

t. The capability should exist for enabling the automatic printout of the temporal file to be printed to a stand-alone networked printer;

u. Provide graphical displays that allow the user to navigate to and view any logged process data, event, health, or alarm from the Portal Monitor and the Supervisory Computer;

v. Display and annunciate quality statuses (e.g., unknown, good, suspect, bad) for readings it acquires or derives from external inputs;

w. Display a status of “Unknown” if the user or the software (programmatically) requests a display of a reading and information on that reading is not available or it has not been updated per its scheduled period;

x. Provide an intuitive, user friendly display of the important performance characteristics of the Portal Monitor for each occupancy. Screen captures of the current “Alarm Printout” screen and “System Set-up” screen are included in Appendix 1. However, differences in display are expected since spectroscopic portals emphasize isotope identification information whereas gross portals emphasize count rate information.

y. Merge, and upon demand display, Portal Monitor radiation data with VIS images. The merged data shall include:

- All camera images
- Detector status
- Alarm status
- Time and date
- Lane identification

z. Store VIS data in a manner correlated with Portal Monitor data:

- All images shall be stored and available at the Supervisory Computer for at least one week.
- All images and data from alarming vehicles shall be stored and available at the Supervisory Computer indefinitely.

2.2.3.9.4 Maximum Configurations

The Supervisory CAS shall be designed to have the capability to control and process up to 32 Portal Monitors simultaneously, each of which could contain a maximum of an 8-Panel detection system, and one of which could contain a 12-Panel detection system.

2.2.3.9.5 Processing Priorities and Allowable Variances

The CAS and Supervisory Computer shall be designed to be capable of performing their functions with the following priority (highest first) and allowable performance variances (in parenthesis):

a. Acquisition of time series and spectral data from the Portal Monitors (see performance Note 1);

b. Acquisition of event-driven data (see performance Note 2);

c. Determination of values, quality statuses, alarm states, and alarm types of time-series and event driven data (see performance Notes 1 & 2);

d. Logging time series data (see performance Notes 1 & 2);

e. Status Panel display on local displays (see performance Note 3);

f. Other information on local displays (see performance Note 4);

g. Calculation of dependent alarm threshold limits and other dependent parameters (see performance Note 5);

h. Servicing Annunciator Assemblies and the Supervisory Computer (see performance Note 6);

i. Servicing the visual identification system (see performance Note 7)

j. Configuring local Portal Computer system parameters (see performance Note 8);

k. Issuing user-selected commands to the Portal Monitors (see performance Note 8.);

Performance Notes:

1. All time-series and spectral data shall be transmitted, received, processed, and logged in near real-time. The acquisition period shall be no more than 0.1 second.
2. All event-driven data shall be transmitted, received, processed, and logged within 1 second of the occurrence of the event.
3. All information appearing on the Status Panel display shall appear within 2 seconds of the responsible occurrence. For time-series information the display shall indicate a value is “Unknown” if it is does not receive an update within 2% of its scheduled update period.
4. All information appearing on a Supervisory Computer’s local displays, other than the Status Panel display, shall appear within 3 seconds of the occurrence. For time-series information the display shall indicate a value is “Unknown” if it does not receive an update within 5% of its scheduled update period.
5. All calculations of dependent parameters, such as dependent alarm threshold limits, shall complete within 3 seconds of the change of the parameter’s last-to-change, independent variable, or if this independent variable is a time-series reading, within 5% of its scheduled update period. All calculations for processing each vehicle’s data shall use the settings and software in place as the vehicle enters the Portal.
6. Information the Supervisory Computer generates for any Annunciator Assembly shall appear within 3 seconds of generation.
7. The visual identification system consists of one to three networked digital cameras. The cameras shall be initialized by the Supervisory Computer software. The cameras are triggered by Occupancy sensor signals and subsequently push their images to a (user selectable) designated location on the supervisory computer using File Transmission Protocol (FTP). Each image is up to 500k bytes in size. The Supervisory Computer software shall associate and store the correct camera images with the associated radiation data for each vehicle passing through a portal. Images shall be associated within 3 seconds of the completion of a vehicle’s passage.
8. These functions shall complete within 5 seconds of their initiation by either the user or programmatically.

2.2.3.9.6 Alarm Data Logging

The Supervisory Computer application software shall capture the following data in a system log for each Portal Monitor alarm:

a. The station identification (an ASCII character string, not be more than 10 characters long, that identifies the crossing, and lane or station at which the alarm occurred);

b. The date and time from the Portal Monitor clock (Year:Month:Day:Hour:Minute:Second);

c. The Panel identifier (position of the detector as a right or left side (defined from facing the front of the vehicle) and high or low mounting);

d. The detector identifier (numerically identifies the detector, and alphabetically identifies the Panel (i.e., A1, A2,….An; B1, B2,…Bn);

e. The alarming detector type (either gamma-ray or neutron or both);

f. The detector readings (the count rate value from the alarming detectors, non-alarming detectors, as well as, the individual and composite energy spectra);

g. The detector background readings used at the time of the alarm (the count rate value from the alarming detectors, as well as the individual and composite energy spectra);

h. The state of all vehicle occupancy, speed and ancillary sensors;

i. The alarm state integer that indicates the following about an alarm:

   - Unknown, implying conditions are not valid for calculating an alarm, and, therefore, the sending device does not know the alarm state of the detector or device;
   - Normal, implying conditions are valid for calculating an alarm, and the detector or device is not in an alarm state;
   - Alarm, implying conditions are valid for calculating an alarm, and the detector is in an alarm state.

j. The alarm type integer indicating the following about an alarm

   - Unknown, implying the sending device does not know the type of alarm (whether or not an alarm exists or not);
   - No Alarm, implying conditions are valid for calculating whether or not a detector/device is in alarm, and it is not in alarm; and
   - High Gamma, High Neutron, Low Limit, etc., implying conditions are valid for calculating whether or not a detector/device is in alarm, and it is in alarm, and this is the type of alarm the alarm processor detected for all readings during the period of the alarm.

k. The capability to enter meta-data associated with each alarm and store this information with the alarm data record. Examples of meta-data include driver information, vehicle information, cargo manifest information, inspector observations, handheld isotope identifier information, etc.

2.2.3.9.7 Routine Data Logging

The Supervisory CAS shall be capable of storing all raw Portal Monitor data, Portal Monitor health data, and vehicle data, for later use, network retrieval, or hardcopy printout. These capabilities shall be selectable by the operator. Levels shall be established to enable the operator to reduce the detail contained in the event logs. As an example, composite gamma spectra from each Panel or from each detector of a Panel shall be selectable by the operator.

2.2.3.9.8 Pre-Formatted Reports (not implemented for ASP prototypes)

The Supervisory Computer application software shall provide summary reports, both printed in color and on screen, upon request and for a configurable period of time.

2.2.3.9.9 Standard Color-Coding of Displays and Printouts

a. The following set of color-coding shall be used on the Status Display Window, Alarm Window, and Alarm Report Printout:
   - RED = Neutron Alarm
   - BLUE = Gamma Alarm
   - ORANGE = “Innocent” Alarm
   - AMBER = System Error/Failure
   - GREEN = Power/System OK
   - WHITE = Checking

b. The same color-coding should be reflected on the Annunciators, as well.

c. All colors used on printouts shall be as close as practicable to colors used on the screen for the same type of information.

2.2.3.9.10 Temporal Profile Requirements

For display and printouts, provide a means to differentiate signals (e.g., neutrons, gamma gross-count and gamma window count) by line weight or line type (dashes, dots, embedded symbols, etc.).

2.2.3.9.11 Alarm Report Display and Printout

2.2.3.9.11.1 Alarm Printout Margins (not implemented for ASP prototypes)

The alarm report printout shall have left and right margins of at least 0.5 in. and top and bottom margins of at least 0.75 in. to facilitate faxing alarm report printout sheets without losing information.

2.2.3.9.11.2 Font for Alarm Report (not implemented for ASP prototypes)

The alarm report printout shall use a Sans Serif font (e.g. Arial) with a minimum of a 10 point font size.

2.2.3.9.11.3 Alarm Report Panel Information

a. Alarm report display and printout shall include counts for each Panel (every Panel assigned to a Portal Monitor) for each alarming segment as follows:

- Background gamma gross-counts
- Background neutron counts
- Maximum gamma gross-counts
- Maximum neutron counts

b. For Alarming Panels, maximum counts should be shown in Bold with the appropriate color-coding:

- RED = Neutron alarm
- BLUE = Gamma Alarm

c. The alarm display and printout shall report the level of threat, if determined, for that occupancy.

d. The alarm display and printout shall report each of the isotopes that were identified (and the associated confidence in the determinations).

e. The display and printout shall classify the type of source(s) (e.g., NORM, SNM, Medical, Industrial, Suspicious).

f. The display and printout shall indicate the types of algorithms that produced an alarm for the vehicle (e.g., neutron gross count, gamma gross count, gamma energy window).

g. The alarm report display and printout shall include net count rates for gamma and neutron detectors. Optionally, the report and printout may also include count rate information for each detector subsystem within the portal.

h. The alarm report display and printout shall include the capability for including up to three images of the vehicle, person or package associated with the occupancy.

- RED = Neutron alarm
- BLUE = Gamma Alarm

Printing of Alarm Report

For the ASP prototypes, hard copy print out shall be provided that documents the key alarming and radiation detection performance information. The detailed printout requirements below labeled (a.-e.) are not required.

a. The alarm report printout shall print on one page if the report format allows without using unduly small font or graph sizes.

b. If the report is longer the one page:

    i. The first page shall print automatically by default, and
    ii. A user-selectable option shall be provided to print the additional pages only upon request of the operator.

c. The first page of the alarm report shall include:
    i. Image. Provide a user-selectable option to designate which image to display (Front, Side, or Rear). By default the Front image shall be displayed.
    ii. The alarm Panel information.
    iii. If both a neutron and gamma alarm occur, both need to be shown on the source location as described below and the alarming Panels color-coded in bold appropriately.
    iv. All non-alarming segment(s) should be shown on the source location area along with the alarming segment(s)
    v. In the source location segments, designate the location of the peak with the following:
        - N (in red) for Neutron
        - G (in blue) for Gamma
    vi. Temporal profile of gamma gross counts and neutron counts.
    vii. Headings for user supplied data as follows: Commodity, Entry Number, Shipper, Consignee, Carrier, License Plate #, Driver, Passenger, Driver DOB, RIID Reading, PRD Reading

d. Subsequent pages of the alarm report shall include:
    i. All images obtained.
    ii. Any additional information.

e. Pagination control shall be used to assure that tables or graphs are not split onto multiple pages.

2.2.3.9.12 Spectrum Output

The Supervisory CAS shall be capable of providing gamma spectra, for off-line analysis by a separate program, in a non-proprietary, publicly revealed format.

2.2.3.9.13 Data Archiving

a. The Supervisory CAS shall provide the means to archive 100% of all the logged data to DVD. User selectable archiving would typically occur on a daily basis (e.g., at midnight) with the possibility for handling multiple daily-archives. Archiving shall be user selectable for all events or only alarming events.

b. Archiving shall allow purging the logged data to make room for newer data, but logged data is only purged when required by disk space limitations.

2.2.3.9.14 Operational Modes

a. The Supervisory CAS shall provide the user the capability to simultaneously run individual Portal Monitors in different operational states.

b. Pass-through mode refers to lane operations where a vehicle is in continuous motion through the Portal Monitor;

c. Wait-in mode refers to lane operations where a vehicle stops temporarily in the Portal Monitor, such as from stop-and-go traffic or an intentional stop to gain enhanced counting statistics; and

d. Idle mode disables a specific Portal Monitor (such as in secondary or a specific lane) for a period of time through a mechanical switch mechanism.

2.2.3.9.15 Echo Computer(s)

The Supervisory CAS shall provide the capability to operate additional (Echo) Computers.

2.2.3.9.16 Third-Party Software Interface Requirements

The Supervisory CAS shall provide the capability for an interface to either an external, supplemental system or program operating on the Supervisory Computer.

2.2.3.9.17 Portal Monitor Gamma Detector and Neutron Detector Performance Check

a. The Supervisory CAS shall implement a method for readily checking the performance of each gamma detector using low-intensity ($\leq$ 10 µCi) check sources spanning a range of energy peaks (e.g., ^{133}Ba, ^{57}Co, and ^{60}Co).

b. This Performance Check shall include both background and source-plus-background measurements. Background and net source counts shall be calculated and displayed or printed.

c. A check of energy calibration and resolution for each gamma-ray sensor element shall be performed. A plot or data log to identify systematic drifts in peak location and resolution shall be provided for both a low-energy (e.g., ^{57}Co) and high-energy (e.g., ^{60}Co) peak.

d. Energy spectra from each individual gamma detector module and composite shall be displayed when checking energy calibration and resolution.

e. This method for checking performance shall be suitable for determination of alarm thresholds when other sources are used, that is, for routine calibration of the system, setting related thresholds, and examining spectroscopic capability of the Portal Monitor.

f. A similar performance checking method on counts shall be provided for use with the neutron detectors and a neutron check source. The Supervisory CAS shall be capable of performing these checks without creating programmatic system interference with the normal operation of other Portal Monitors or Portal Monitors in a multi-portal system.

g. The Supervisory CAS shall be capable of implementing other user-supplied performance checks, such indications determining whether the minimum detectable activity level has degraded by some relative measure. No additional performance checks will be supplied for the ASP prototypes.

2.2.3.10 Annunciator Assembly Indications and Controls

a. Alarm and indication lights shall be colored lenses (or LED arrays) as follows:
   - RED = Neutron Alarm
   - BLUE = Gamma Alarm
   - AMBER = System Error/Failure
   - GREEN = Power/System OK
   - WHITE = Checking

b. Lights shall have a luminous intensity greater than 1500 mcd (millicandela) to be viewed in direct sunlight.

c. Lights shall have a life expectancy greater than 100,000 hours.

d. The ASP prototype shall have the ability to test the lights.

e. The following alarm lights shall be included:
   - *Instrument Failure*. "ON" indicates failure of the gamma or neutron detector.
   - *Neutron Alarm*. "ON" indicates a neutron alarm.
   - *Gamma Alarm*. "ON" indicates a gamma alarm.

f. The following indication lights shall be included:
   - *Power*. "ON" indicates that there is power from the Control Box to the Annunciator Assembly, and the Control Box Computer is functioning properly. "FLASHING" indicates that normal power is lost and the system is operating on battery backup.
   - *Checking*. "OFF" indicates that the Portal is Disabled. "ON" indicates that that the portal is Enabled and ready to conduct measurements. "FLASHING" indicates that a vehicle is present and a measurement is being conducted.

g. The Annunciator Assembly shall have speaker capability for audio (voice) alerts for all alarms (Instrument Failure, Gamma Alarm, and Neutron Alarm).

h. The Interior Annunciator Assembly shall have an internal speaker.

i. The audio shall be adjustable at least three levels between 68 decibel and 90 decibels. (not implemented for ASP prototypes).

j. A key operated three-position switch shall be provided with the following positions:
   - *Disable*. This position will prevent the Portal Monitor from accumulating data on vehicles or producing alarms and indications.
   - *Enable*. This position will be for normal operation.
   - *Reset*. Moving the switch to Reset will cause a Portal Monitor reset and begin a background count. While the switch is in Reset all lights shall illuminate as a lamp test feature. The switch shall be spring returned automatically to the Enable position.

k. The three-position switch shall be key-operated between the positions of Disable and Enable only.

l. The three-position switch shall be capable of being re-keyed, including the capability of requiring key operations between the positions of Acknowledge and Reset.

m. A separate silence/acknowledge button shall be provided. A single depression of this button will cause the audible alarm to stop. Depressing a second time will cause the alarming condition to clear.

n. Normally, only one Annunciator Assembly will be required. However, when more than one (up to six) Annunciator Assemblies are deployed, the following requirements of simultaneously operability shall be met (not implemented for the ASP prototypes):

    1) Any key operated three-position switch in the Disable position will prevent the Portal Monitor from accumulating data on vehicles or producing alarms and indications.

    2) With all three-position switches in the Enable position any Annunciator Assembly may be used to acknowledge or reset alarms.

    3) An alarm acknowledged or reset at an individual Annunciator Assembly must be automatically acknowledged or reset at all other Annunciator Assemblies for that Portal Monitor.

2.2.4 Speed Control

The following design features are specified in addition to the speed control features specified in ANSI N42.38-WD-F1a (Draft).

2.2.4.1 Occupancy and Speed Sensor Types

Due to a wide array of deployment environments and applications, the Portal Monitor shall be designed to be capable of accommodating:

a. In-ground, inductive-loop type sensor systems;

b. Optical, break-beam type sensor systems, and

c. Reflective beam type sensors.

For ASP prototypes optical, break-beam type sensors will be supplied and implemented.

2.2.4.2 Occupancy and Speed Sensor Performance

The vehicle Occupancy Sensor shall:

a. Operate on a mix of traffic (cars, vans, pickup trucks, buses, cargo trucks, trains, boxes, etc.);

b. Detect and determine speeds for vehicles traveling at speeds up to 30 mph;

c. Not count a single vehicle in its field of view more than once;

d. Detect unloaded vehicles and extension reaches used with truck and pup combinations;

e. Measure vehicle position;

f. Compare measured speed to a speed limitation and generate a speed alarm;

g. Determine vehicle speed with 10% precision;

h. Determine if a vehicle stops within the portal and for how long.

2.2.4.3 Ancillary Sensor Types and Performance

The vehicle Ancillary Sensors shall:

a. Operate on a mix of traffic (cars, vans, pickup trucks, buses, cargo trucks, trains, boxes, etc.);

b. Record ancillary data at 0.1 second intervals.

2.2.5 Environmental Protection

The following design features are specified in addition to the moisture protection features specified in ANSI N42.38-WD-F1a (Draft).

2.2.5.1 Corrosion

The ASP prototypes, including the Support Structure, shall be designed, installed, and maintained to minimize the potential for corrosion.

2.2.5.2 Paint

All steel surfaces shall be properly prepared and painted. The process for the existing systems is to sandblast to near white metal in accordance with SSPC-SP10, and coat with 3.0-4.0 mils Dry Film Thickness (DFT) zinc rich epoxy primer Carbozinc 859, or equivalent, and followed by finishing with 2.0-2.5 mils DFT high gloss polyurethane enamel Carbothane 134, or equivalent. Contribution of the paint to the gamma background shall be minimized.

The Support Structure color shall be OSHA "Safety Yellow," or equivalent. Other outdoor equipment (Control Box, Uninterruptible Power Supply, Radiation Sensor Panels, and External Annunciator Assembly) shall be "True White."

2.2.5.3 Humidity

Portal Monitor equipment located outdoors or indoors shall be capable of operating in ambient relative humidity up to 93% at an ambient temperature of +40° C. (See IEC 60068-2-56)

2.2.5.4 Enclosure Environmental Requirements

a. Unless otherwise specified, all exterior enclosures shall conform to the NEMA 250-2003 for enclosure type 4X (preferred) or be capable of meeting the requirements for NEMA type 4X.

b. The Uninterruptible Power Supply Enclosure shall be NEMA 3RX rated, or be capable of meeting the requirements for NEMA type 3RX, to facilitate ventilation for the battery.

2.2.5.5 Ambient Outside Temperature

a. All components of the Portal Monitor designed for outside deployment shall be capable of meeting the other specifications described in this document while operating in ambient temperatures from –40° C to +55° C.

b. Heater systems may be designed into the Panel subject to the total power limitation per Portal Monitor.

c. Sensor components shall be adequately protected from thermal shock due to rapid changes in outside temperature and/or heat buildup within the enclosure.

2.2.5.6 Mechanical Shock and Vibration

a. Portal Monitor equipment shall be unaffected, and shall not alarm, when subjected to mechanical shock and vibration, transmitted through air, structures, or the ground, caused by passing or stationary vehicles in the inspection area, including trucks and trains and acoustically induced vibration (i.e., internal combustion engines and rolling equipment).

b. Shock mounting shall be provided to protect fragile detector crystals from damage.

c. Specific accelerations and frequency criteria are specified in ANSI N42.38-WD-F1a (Draft).

2.2.5.7 Electromagnetic Interference

The ASP prototypes shall be designed to be unaffected, and not alarm, when subjected to electromagnetic fields of 20 Volts/meter (time-averaged field strength) at frequencies from 150 kHz to 2 GHz.

2.2.5.8 Electromagnetic/Radio Frequency Emissions

The Portal Monitors shall be designed to conform to the FCC Part 15, Subpart B, Class B Electromagnetic/Radio Frequency Interference (EMI/RFI) emissions standard.

2.2.6 Markings

The following design features are specified in addition to the marking features specified in ANSI N42.38-WD-F1a (Draft).

2.2.6.1 Component Marking

All interior components of the Portal Monitor shall be permanently marked with model and serial number in a readily accessible location.

2.2.6.2 Marking

a. Portal Monitors shall be labeled as required by FCC Part 15, Subpart B, Class B, Section 15-19, Labeling Requirements.

b. Enclosures containing electrical components shall be constructed, inspected and labeled as specified in ANSI/UL 508-2003 or equivalent.

c. Markings required by standards, such as ANSI, AWS, ASME, UL, NEMA and others shall be included as required by the standards.

d. There shall be no other external markings (offeror name, offeror logo, or other symbols) except the serial number.

2.2.7 Uninterruptible Power Supply (UPS) for Portal Monitor

For the ASP prototypes the UPS shall meet the requirements as agreed upon by the Offeror and the ASP Program Office.

As a reference, for existing systems, the UPS will:

a. Operate with a line voltage of 102 to 132VDC and 57 to 61 Hz.

b. Not require more than 200 watts AC supply current during steady state operations and 500 peak watts during battery recharge.

c. Maintain sufficient battery capacity to power the Portal Monitor for a minimum of 3 hours on the loss of AC supply voltage;

d. Indicate when the battery is in discharge;

e. Recover the battery to a fully charged state within three hours following a three hour discharge; and

f. Not power Portal Monitor heaters or coolers (if present) in the Panels.

g. Protect the powered equipment from transients including lightning.

2.3 Isotope Identification Performance Requirements

The Portal Monitor computer application software (CAS) shall process and store the gamma spectra to identify and categorize specific isotopes and display the results. The Portal Monitor CAS shall meet isotope identification requirements specified in ANSI N42.38-WD-F1a (Draft) as modified below.

Table 2-2 is drawn from ANSI N42.38 – WD – F1a.

Table 2-2 Activities Values for Gamma and Neutron Sources[(1)] [(2)]

Radionuclide	Activity (μCi) (unshielded)	Activity (μCi) Steel Shielded (3 cm)	Activity (μCi) Steel Shielded (6 cm)	Activity (μCi) Poly Shielded (7.62 cm)[(5)]
^{241}Am	47	--		--

^{133}Ba	9	148	1500	--
^{57}Co	15	8770	230,000	--
^{60}Co	7	25	92	--
^{137}Cs	16	85	450	--
DU(4)	4.5 kg (46 cm^2)	--		--
^{67}Ga	16	--		94
HEU(4)	237 g (6.5 cm^2)	--		--
^{131}I	10	--		23
^{192}Ir	6	61	525	--
^{40}K	128	--		--
^{237}Np(4)	90 mg with 1 cm Fe shielding	--		--
^{99m}Tc	16	--		127
^{201}Tl	10	--		88
^{226}Ra	8	--		--
^{232}Th	14	--		--
RGPu(4)	1.4 g with 1 cm Fe shielding	--		--
WGPu(4)	15 g with 1 cm Fe shielding	--		--
^{252}Cf(3)	2×10^4 n/s $\pm$ 20%	--		--

(1) – Values stated are based on calculations performed using published information available at the time of drafting, and are based on photon emission rates using those photons with energies greater than 25 keV with radioactive material contained in a 0.25 mm stainless steel encapsulation. An emission rate of 500,000 dps was used as a basis. This was determined using the emission rate of ^{137}Cs for an exposure rate of 5 µR/hr at 1 meter.

(2) - The actual activity of each source at the time of testing shall be not more than 20% greater than the value shown in Table 2-2. The uncertainty in the actual activity value shall be less than 10% (1σ).

(3) - The neutron source is encapsulated in 1 cm steel but otherwise unshielded.

(4) – The shown mass values are based on a total gamma leakage of 500,000 gammas/second at energies greater than 40 keV. The amounts of HEU and DU are stated in terms of cross-sectional area as well as the mass of solid spheres. This is because these sources are surface emitters and the cross-sectional area determines the flux. WGPu, RGPu, and 237Np are shielded with 1 cm Fe for handling purposes due to ES&H issues and for particularly Pu, they emit quite a few low-energy gamma rays that don't contribute to the ability to identify the isotopes. 20 years age is used as a basis for the transport calculations.

(5) – "Poly" = poly methyl methacylate.

2.3.1.1 Deviations from ANSI N42.38-WD-F1a (Draft)

Deviations from the requirements contained in ANSI N42.38-WD-F1a (Draft) are listed below.

a. Detection of the isotope ^{232}U, which is a common contaminant in Highly Enriched Uranium (HEU), has been added as an additional requirement. Radiation emitted by this isotope is very similar to ^{232}Th except for emission in the 911-keV region, which is associated with the ^{232}Th daughter ^{228}Ac. The ambiguous situation, including most NORM cargo, where the 2614-keV peak is not intense enough to expect a 911-keV peak shall be addressed.

b. Although they are not specifically defined as SNM, the isotopes ^{232}U and ^{238}U shall be treated as a special category labeled "Suspicious" because these isotopes may be associated with SNM. Although ^{238}U is a naturally occurring isotope, the emitted radiation is dominated by emission from ^{226}Ra and its daughters unless it has been chemically separated. Therefore, ^{238}U should not be reported as NORM, as implied by ANSI N42.38-WD-F1a-2004 (Draft). The threshold settings will normally be configured to alarm when these isotopes are identified.

c. ^{131}Cs has been added as a medical isotope for the Isotope Library. ^{131}Cs is a new, low-energy isotope recently approved by the Food and Drug Administration for general use in seed implants for treating prostate and breast cancer.

d. The requirements for testing for Electromagnetic Interference have been changed (Section 2.2.5.7.)

2.3.2 Isotope Library

2.3.2.1 Gamma-emitting Isotopes

The Portal Monitor CAS shall identify and categorize all of the isotopes listed below. The parent isotope shall be reported for isotopes that are generally found to be in equilibrium with a series of daughter isotopes (e.g., ^{226}Ra, ^{232}Th).

- *Naturally occurring radioactive materials (NORM)*: ^{40}K, ^{226}Ra, ^{232}Th
- *Special nuclear materials (SNM)*: ^{233}U, ^{235}U, ^{237}Np, ^{239}Pu (both weapons grade plutonium and reactor grade plutonium are to alarm, because the sensors are not expected to measure the ^{240}Pu/^{239}Pu ratio to determine plutonium isotopic composition to determine the grade)
- *Medical radionuclides*: ^{18}F, ^{51}Cr, ^{67}Ga, ^{75}Se, ^{89}Sr, ^{99}Mo, ^{99m}Tc, ^{103}Pd, ^{111}In, ^{123}I, ^{125}I, ^{131}I, ^{131}Cs, ^{153}Sm, ^{201}Tl, ^{133}Xe
- *Industrial isotopes*: ^{57}Co, ^{60}Co, ^{133}Ba, ^{137}Cs, ^{192}Ir, ^{226}Ra, ^{241}Am
- *Suspicious*: ^{232}U, ^{238}U

2.3.2.2 Gamma-emitting Shielded Isotopes

- The Portal Monitor shall identify and categorize shielded isotopes or those concealed within cargo.
- The Offeror shall list those isotopes from 2.3.2.1 that can be identified and categorized when shielded by 3 cm and 6 cm of steel.

2.3.2.3 Provisions for Adding Isotopes to the Library

The Portal Monitor CAS shall permit the User to add additional isotopes to the library and modify the detection and identification algorithms accordingly.

2.3.3 Isotope Combinations

a. The Portal Monitor CAS shall identify isotopes when they appear in combination with other isotopes.

Note: This is an essential capability because additional isotopes may be found in association with cargo containing NORM (^{40}K, ^{226}Ra, and ^{232}Th). Administration of combinations of medical radionuclides is another common example of mixed isotopes. Special nuclear materials may also be found in combination. Even when they are observed independently, HEU and plutonium each comprise at least two radioactive isotopes.

b. When presented with isotope combinations that include both NORM and SNM/RDD sources (from ANSI-N42.38-WD-E (Draft)), the Portal Monitor CAS shall, with high confidence, provide indication that the observed spectrum is unlikely to be due to NORM alone. Subsequent correct identification of the non-NORM isotopes should be provided,.

2.3.4 Isotope Identification Confidence Estimates

The Portal Monitor CAS shall have the capability to provide information regarding the confidence or level of uncertainty of any isotopic identification.

The Offeror shall document the criteria used to define levels of confidence. For example: High indicates greater than 95% confidence; Medium indicates 80-95% confidence; and Low indicates less than 75% confidence.

2.3.5 Method for Utilizing Data from Multiple Detectors

The Portal Monitor CAS shall have provisions for utilizing data from multiple detectors to maximize the statistical confidence.

2.3.6 Alarm Algorithms

a. Portals shall use threat-based alarming algorithms. The algorithms may include any or all of the following characteristics: identified isotopes; confidence in the isotope identifications; estimates of isotope quantities; quality of fit (if applicable); the gross count rate; the gross neutron count rate; the cumulative threat associated with combinations of isotopes that are deemed to be suspicious.

b. The Portal Monitor CAS shall support the logical combination of information from gross counting and isotopic analysis as part of threat-based alarming. It shall be possible to enable isotopic–based alarm algorithms in a complex logical “OR”, “AND”, and “NOT” condition with threshold-based algorithm methods.

Note: This algorithm methodology can assist in the rejection of naturally occurring radioactive material (NORM) and medical isotope products. For example, it shall be possible to over-ride (as selected by the User) a gross count alarm when fully explained by the identification is of one or more NORM or medical isotopes. However, the identification of NORM isotopes shall not over-ride any clear SNM- or suspicious material-indicating peak or condition.

c. The thresholds used for the alarming algorithms shall be adjustable, but the ASP will “boot-up” in a Default Mode deemed suitable for normal operations.

2.3.7 Desired Performance Capabilities

The following are desired, but not required, capabilities. Having these capabilities will significantly improve the ASP threat detection capabilities and will be viewed favorably during performance evaluation.

a. The detection and identification of beta-particle emitting isotopes, such as ^{32}P, and ^{90}Y ^{90}Sr, is desirable.

b. The identification of ^{252}Cf is desirable. The isotope ^{252}Cf emits neutrons plus a prompt fission continuum of gamma rays. Although this emission is difficult to distinguish from other neutron sources, especially ^{240}Pu, the characteristic peaks from ^{252}Cf and ^{249}Cf, which is a contaminant in old Cf, may assist in attributing the emitted radiation to Cf.

c. The identification of (alpha,n) neutron sources (e.g., Pu/Be or Pu/F) by characteristic peaks is desirable.

d. The determination of large source activities as a means for identifying potential Radiation Dispersal Devices (RDDs) is desirable.

3.0 TESTING REQUIREMENTS

3.1 Factory Acceptance Testing (FAT)

3.1.1 Spectroscopic Identification Testing Requirements

Prior to delivery for testing, Offeror shall perform tests (in the presence of an HSARPA technical representative) to ensure that the ASP system meets minimal functionality and performance requirements over the entire detection zone.

a. Type testing shall be conducted in a Standard Cargo Vehicle configuration. ASP systems shall identify and categorize each of the gamma-emitting isotopes source types listed in Table 3-1, when those isotopes are exposed to the ASP system individually without shielding and when shielded by 3 cm steel.

b. The ASP system must also identify the presence of a neutron source when it is exposed to the ^{252}Cf source.

c. The ASP system shall identify and categorize the sources in Table 3-1 when those those sources are presented unshielded, but in combinations.

d. The ASP system shall identify and categorize NORM materials, including (1) KCl road de-icing salt and (2) any common NORM material of commerce (containing a combination of ^{40}K, ^{226}Ra, ^{228}Th, and ^{238}U), such as kitty litter and ceramic materials/products. Quantity and type of NORM material are to be determined by the Offeror.

e. Offeror shall validate compliance with 2.2.2.1.5 Radiation Panel Gross Counting Capability either prior to or during FAT.

f. Offeror shall provide documentation of the test results for each ASP system that is delivered.

f

Table 3-1 Source Isotopes and Activities for Factory Acceptance Testing

Isotope	Maximum Activity (μCi) - unshielded	Maximum Activity (μCi) - shielded with 3 cm steel	Maximum Activity (μCi) - shielded with 15 cm polyethylene
^{241}Am	47 μCi	N/A	N/A
^{57}Co	15 μCi	8770	15
^{133}Ba	9 μCi	148	9
^{137}Cs	16 μCi	85	16
^{60}Co	7 μCi	25	7
^{252}Cf	5 μCi (2×10^4 n/s)		

3.2 User Adjustment of Alarming Algorithms

Offeror shall demonstrate capability to change alarming algorithm including adjustment of alarming thresholds and adjustments to isotope-based alarming algorithms. The vendor will not be allowed to adjust the ASP prototypes for various test conditions.

4.0 DOCUMENTATION

The Offeror shall prepare the following documentation. All documents shall be prepared in English (including all software, drawings, examples, and configuration files) and available for inspection at least 2-weeks prior to the first equipment delivery. Additional documentation is required from Offerors to support site preparation, training and approvals for the Operational Evaluation. A schedule for these additional documents will be provided.

4.1 Installation Manual

Installation Manual - The Offeror shall provide an assembly/installation manual for each Portal Monitor that includes specifications for the general contractor, site preparation, installation instructions, Offeror directions for system line up/testing, energizing equipment, and the staff qualifications required for installation.

Portal Monitor components must be packaged to withstand probable affects of transportation, handling, and storage. Specific transportation, handling, and storage instructions to mitigate unacceptable conditions shall be specified by the Offeror in the installation manual.

Offeror shall disclose the presence of hazardous materials, embedded radiation sources or energy sources. Procedures and/or precautions for working on or around the identified hazards shall be included in the manual.

4.2 Operations Manual

The Offeror shall provide an operations manual. The manual will describe how the User will operate the ASP system in all modes (locally and remotely), including system startup, configuration, commands, access and views of outputs, and performing diagnostics. Screen displays shall accompany the descriptions.

Operations Manual shall indicate the presence of hazardous materials, embedded radiation sources or energy sources. Procedures and/or precautions for working on or around the identified hazards shall be included in the manual.

The operations manual shall include:

- Descriptions of operating parameters;
- The minimum configuration for Portal Monitor operability;
- Procedures needed to startup, confirm operability, operate, and shutdown the Portal Monitor;
- A complete description of the minimum set of parameters to be checked to verify proper operation of the Portal Monitor;
- Offeror drawings and schematics required to operate the equipment;
- A point of contact for operational issues; and
- The presence of any chemically hazardous liquids, gases or other materials.

4.3 Maintenance Manual

A maintenance manual shall be provided for each ASP system installation. The maintenance manual shall include:

- Troubleshooting guide.
- Local servicing/equipment replacement procedures.
- Regional maintenance and Offeror points of contact.
- Offeror drawings and schematics required by the operator to maintain the equipment.
- Preventive and Corrective Maintenance Scenarios.

The Offeror will justify the approach to be used to repair and replace failed components, including:

- Parts serviced/replaced by local servicing entity.
- Parts serviced/replaced by regional servicing entity.
- Parts serviced/replace by Offeror.

The Offeror will identify the location of spare parts and provide an inventory management system. The staging of replacement or repair parts will be risk informed and support the overall reliability assumptions and recovery estimates for the facility.

5.0 INTERFACE DEFINITIONS

A.1 PORTAL MONITOR TO REMOTE STATION INTERFACES

Interface Definition 01, Portal Computer – Supervisory Computer

a. The Portal Monitors for any given location shall communicate with the Supervisory Computer via an Ethernet connection using the TCP/IP protocol.

b. The communications network shall operate at least 100 Mbps.

c. The Offeror shall use network interfaces compatible with commercially available 100Base-F/100Base-T networking equipment.

A.2 PORTAL MONITOR TO VEHICLE ID AND CONTROL INTERFACES

Interface Definition 02a, Portal Computer Interface – Occupancy Sensor Data Interface Definition

The Portal Computer shall have the capability to interface with two types of Occupancy Sensors, including break-beam type and inductive loop type (only optical break-beam sensors will be implemented in ASP prototypes). The following characteristics of Occupancy Sensors shall be supported by the Portal Computer:

a. Voltage source shall be 24 VdcVDC with connections for four 18 to 22 AWG wires;

b. Grounding connections for four 18 to 22 AWG wires shall be provided;

c. Power output to Occupancy Sensors shall be capable of supporting at least 16 watts;

d. The signal return from Occupancy Sensory to the Portal Computer shall be switched logic as binary voltage between 5 to 32 VdcVDC; and

e. Signal return connections for four 18 to 22 AWG wires shall be provided.

Interface Definition 02b, Portal Computer Interface – Port Systems Interface Definition

The Portal Computer shall have the capability to interface with auxiliary systems such as traffic controllers, and imaging equipment (only Vehicle Identification System will be implemented for ASP prototypes). The following standardized output signals shall be provided from the Portal Computer at a connection location inside the Control Box for use by other port systems:

a. Three Transistor-Transistor Logic (TTL) RJ-45 connection points shall be provided in the Control Box.

b. The Control Box shall have a penetration available for routing up to three Category 5 (CAT 5) cables.

c. The penetration shall maintain the NEMA 4X rating of the Control Box.

d. Logic to the three RJ-45 connections shall be TTL.

e. Connection 1: One RJ-45 connector shall include software triggers with the following PIN description:

- 1 +5 volts DC

- 2 Reference ground
- 3 Power indicator (High indicates ON)
- 4 Gamma alert indicator (Low indicates alert)
- 5 Neutron alert indicator (Low indicates alert)
- 6 System error indicator (Low indicates error)
- 7 Occupancy Sensor entry (entrance to ASP) indicator (Low indicates vehicle present)
- 8 Occupancy Sensor exit (exit from ASP) indicator (Low indicates vehicle present)

  i. Alert and error indicators on PINs 4, 5 and 6 shall latch low and remain low until the condition is cleared at the Annunciator Assembly.

  ii. Occupancy Sensor indicators on PINS 7 and 8 shall become Low and remain Low when the vehicle is present. They shall become High and remain High when the vehicle is not present.

  iii. When more than one Occupancy Sensor is used at the entry to the RPM the Occupancy Sensor signal on PIN 7 shall be an "OR'ed" signal, so that the detection of the vehicle by any entry Occupancy Sensor causes the Low signal.

  iv. When more than one Occupancy Sensor is used at the exit from the RPM the Occupancy Sensor signal on PIN 8 shall be an "OR'ed" signal, so that the detection of the vehicle by any exit Occupancy Sensor causes the Low signal.

f. Connection 2: A second RJ-45 connector shall include software triggers with the following PIN description:

- 1 +5 volts DC
- 2 Reference ground
- 3 Running on battery power indicator (Low indicates ON)
- 4 Enable/disable status (Low indicates disabled)
- 5 Future use
- 6 Future use
- 7 Future use
- 8 Future use

g. Connection 3: A third RJ-45 connector shall include buffered and isolated hardware occupancy triggers with the following PIN description:

- 1 +5 volts DC
- 2 Reference ground
- 3 Optical sensor entry (lower mounted) indicator (Low indicates vehicle present)
- 4 Optical sensor entry (upper mounted) indicator (Low indicates vehicle present)
- 5 Optical sensor exit (lower mounted) indicator (Low indicates vehicle present)

- 6 Optical sensor exit (upper mounted) indicator (Low indicates vehicle present)
- 7 Inductive loop sensor entry indicator (Low indicates vehicle present) – not implemented for ASP prototypes
- 8 Inductive loop sensor exit indicator (Low indicates vehicle present) - not implemented for ASP prototypes

  Optical sensor and Inductive loop sensor indicators on PINs 3, 4, 5, 6, 7, and 8 shall become Low and remain Low when the vehicle is present. They shall become High and remain High when the vehicle is not present.

A.3 PORTAL MONITOR INTERNAL INTERFACES

Interface Definition 03, Portal Computer - Uninterruptible Power Supply

a. The Uninterruptible Power Supply shall operate on an input range of 90 to 150 Volts AC

b. The Uninterruptible Power Supply shall operate on less than 200 W.

c. The Uninterruptible Power Supply shall be designed to be mounted on the outside surface of the Support Structure.

d. The Offeror shall modify drawing A.1 with the bolt pattern required to mount the Uninterruptible Power Supply. To facilitate installation of the Uninterruptible Power Supply on either side or the back of the Support Structure a redundant set of bolt patterns shall be included on the opposite side of the Support Structure and on the back side of the Support Structure. The Offeror's bolt pattern shall facilitate mounting the Uninterruptible Power Supply so that it is below the Control Box, but at least 2 feet from the bottom of the Support Structure.

e. The Uninterruptible Power Supply shall include the same bolt pattern to enable it to be mounted to a Support Structure.

A.4 PORTAL MONITOR TO SUPPORT STRUCTURE INTERFACES

Interface Definition 04, Radiation Sensor Panel – Support Structure

a. Panel Size. The Panels shall fit within the existing structure dimensions of: 93.7 cm (36.87 in.) wide, 222.9 cm (87.75 in.) tall, and 40.6 cm (16 in.) deep.

b. Panel Support.

- All Support Structures shall be designed with the Panel mounting bolt pattern shown in Figure 5-1.
- Panels shall be designed to mount to the Support Structure with the correct orientation using the bolt pattern shown in Figure 5-1.
- The position of the Panel within the support structure shall maintain the gap between two Panels, when stacked vertically, to less than 5.0 cm.

c. Panel Recess. The support structure provides radiation shielding for the Panels to limit the detector field of view. The Panel design shall orient the detector plane to be recessed 2.54 cm (1.0 in.) from the open plane of the support structure.

Interface Definition 05, Occupancy Sensor – Support Structure

a. The break-beam type Occupancy Sensors shall be designed to be mounted on the inside surface of the sides of the Support Structure. Note: Alignment of break-beam type Occupancy Sensors is critical. They must be mounted to prevent movement by hand.

b. The Offeror shall modify Drawing 5.1 with the bolt pattern required to mount the break-beam type Occupancy Sensors. To facilitate installation of the break-beam type Occupancy Sensors on either side of he Support Structures a redundant set of bolt patterns shall be included on the opposite side of the Support Structure.

c. The break-beam type Occupancy Sensors shall include the same bolt pattern to enable it to be mounted to a Support Structure.

Interface Definition 06, Control Box – Support Structure

a. The Control Box shall be designed to be mounted on the outside surface of the Support Structure.

b. The Offeror shall modify Figure 5.1 with the bolt pattern required to mount the Control Box. To facilitate installation of the Control Box on either side or the back of the Support Structure a redundant set of bolt patterns shall be included on the opposite side of the Support Structure and on the back side of the Support Structure. The Offeror's bolt pattern shall facilitate mounting the Control Box so that the top surface of the Control Box is 60 in. from the bottom of the Support Structure.

c. The Control Box shall include the same bolt pattern to enable it to be mounted to a Support Structure.

Interface Definition 07, Exterior Annunciator Assembly – Support Structure – not required for ASP prototypes.

a. The Exterior Annunciator Assembly will be designed to be mounted above the Control Box on the outside surface of the Support Structure

b. The Offeror shall modify Figure 5.1 with the bolt patterns required to mount the Exterior Annunciator Assembly. To facilitate installation of the Exterior Annunciator Assembly on either side or the back of the Support Structure a redundant set of bolt patterns will be included on the opposite side and on the back side of the Support Structure. The offeror's bolt pattern shall facilitate mounting the Exterior Annunciator Assembly so that the top surface of the Exterior Annunciator Assembly is 68 in (plus or minus 2 in) from the bottom of the Support Structure.

c. The Exterior Assembly must include the same bolt pattern to enable it to be mounted to a Support Structure.

A.5 SUPPORT STRUCTURE INTERFACES

Interface Definition 08, Portal Monitor Foundation – Support Structure

All Support Structures will be designed with the ASP Foundation mounting bolt pattern shown in the "Bottom View" of Figure 5.1 to enable Support Structures to be mounted to the Support Structure Foundation.

Interface Definition 09, Support Structure – Support Structure

All Support Structures will be designed with the Support Structure mounting bolt pattern shown in the “Side View” and “Back View” of Figure 5.1 to enable Support Structures to be mounted to other Support Structures.

Interface Definition 10, Support Structure – Auxiliary Structures

The offeror shall modify Figure 5.1 with the bolt patterns required to mount the Auxiliary Structures such as cable-way harnesses, and lighting.

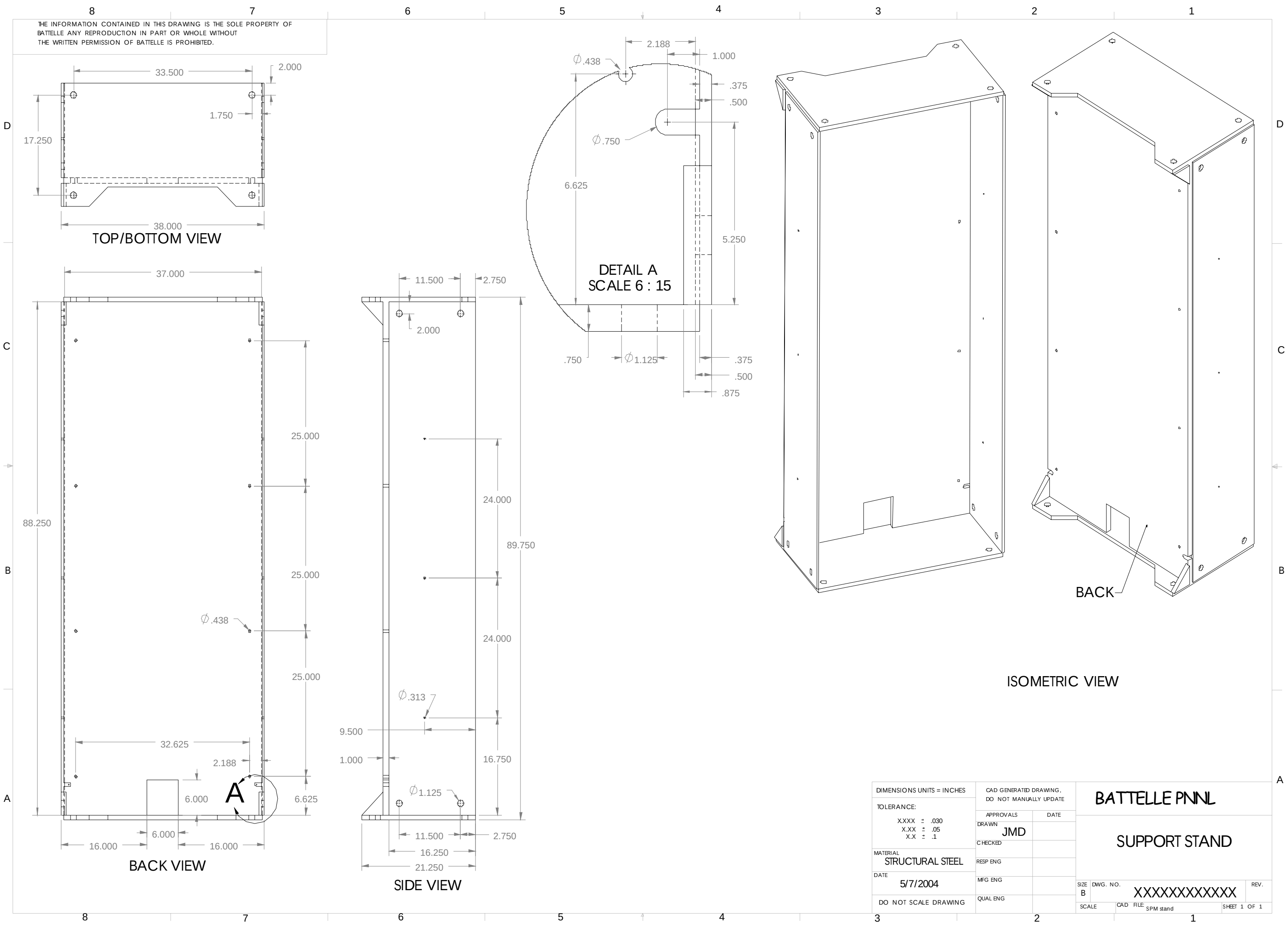

Figure 5.1. Support Structure Drawing

APPENDIX 1: CURRENT APPLICATION SOFTWARE SCREEN CAPTURES (FOR INFORMATION ONLY)

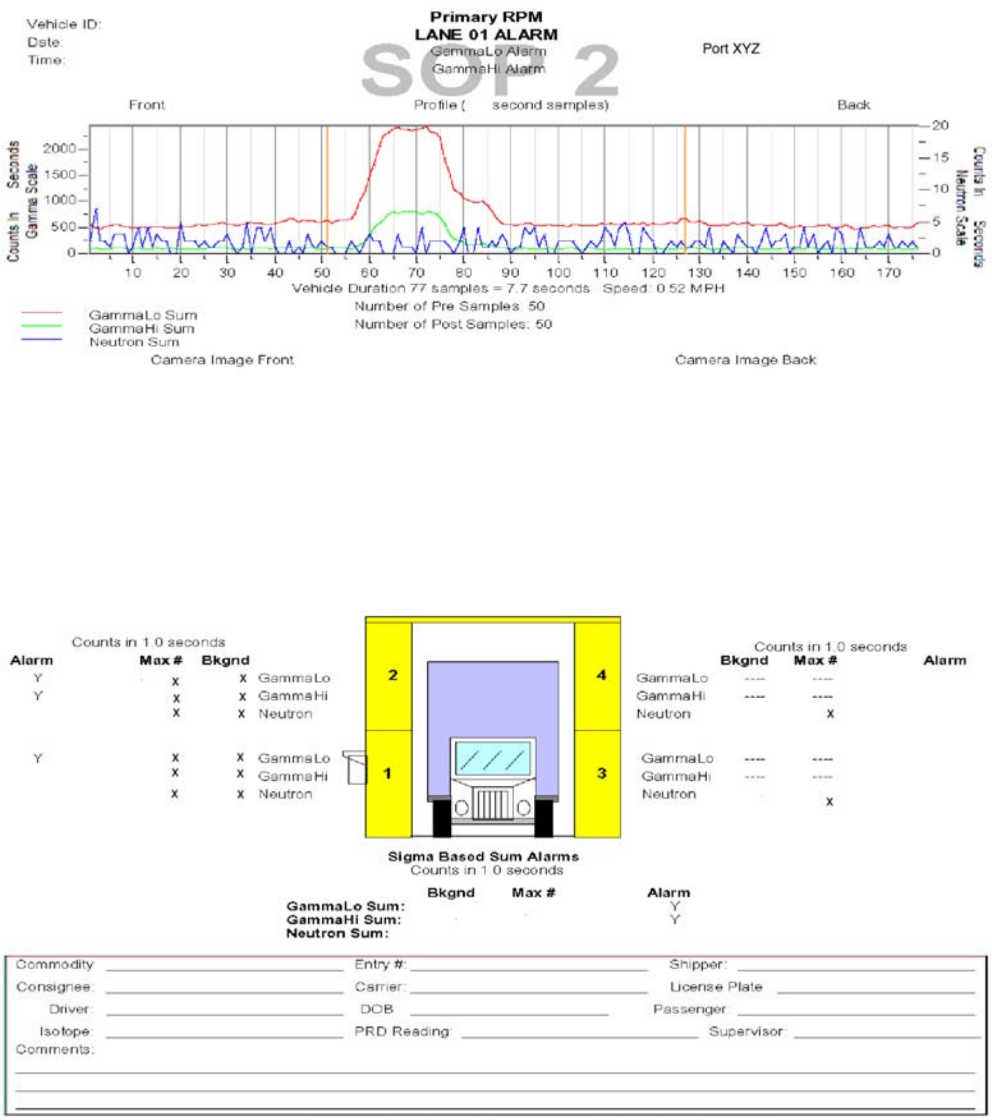

Figure A1-1. Alarm Printout Example

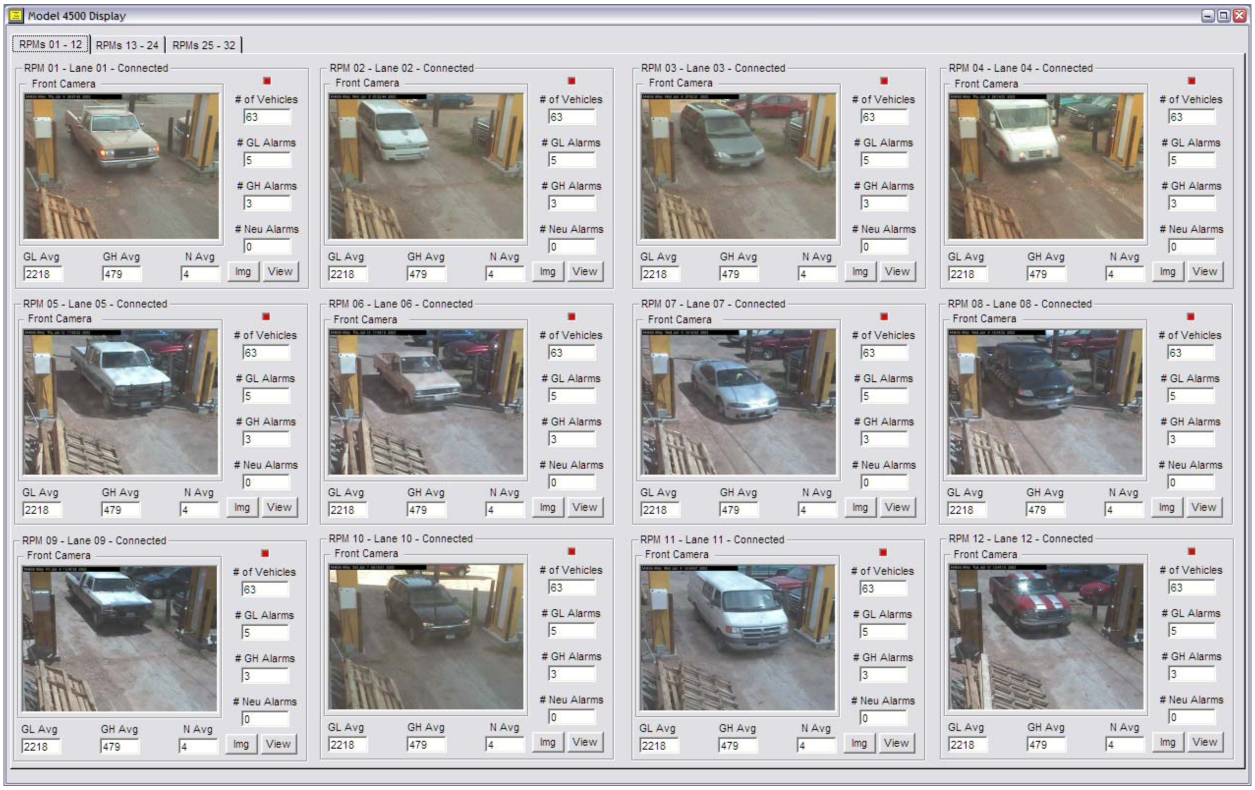

Figure A1-2. System Status Screen Example (for information only)

APPENDIX 2: METHODS FOR DETERMINING GROSS THRESHOLD LEVELS

Standard Deviation Method.

For this method, alarm thresholds shall be calculated in terms of the standard deviation of the background count rate. The alarm threshold will be set according to the following relation, where A is the alarm threshold count value, M is user-input sigma multiplier value, B is the background average background count rate in cps, and t is the settable measurement time interval over which the survey is being performed.

$$A = (t \cdot B) + \left(M \cdot \sqrt{t \cdot B}\right)$$

The last term provides an increase in the threshold above the target value to decrease the probability of a false alarm. For example, if the detector's latest background update produced B=100 cps, the survey time for a measurement is t=1 second, and the user specifies a 4-sigma increase (M=4) over the measured background as the alarm threshold, the analysis/control software would calculate and use an alarm threshold of 140 counts for that measurement.

Absolute Counts Method

For this method, alarm thresholds shall be calculated in terms of an absolute count rate. The alarm threshold will be set according to the following relation, where A is the alarm threshold count value, C is user-input count rate value, B is the background average background count rate in cps, and t is the measurement time interval over which the survey is being performed.

$$A = t \cdot (B + C) - 3\sqrt{t \cdot (B + C)}$$

The last term provides a 3-sigma reduction in the threshold below the target value to ensure a high probability of an alarm. For example, if the detector's latest background update produced B =100 cps, the survey time for a measurement is t =1 second, and the user specifies 100 cps over the measured background as the alarm threshold, the Analysis/Control Software would calculate and use an alarm threshold of 157 counts for that measurement.

Speed Correction

For both of the above methods, it shall be possible to enable a speed correction factor. For example, this may be accomplished as an appropriate speed dependent adjustment to the averaging time, or as a speed dependent adjustment to the alarm threshold value. The Offeror shall describe the speed correction method.